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GALILEO AND THE SCIENTIFIC REVOLUTION OF THE SEVENTEENTH CENTURY

MODERN science did not spring perfect and complete, as Athena from the head of Zeus, from the minds of Galileo and Descartes. On the contrary, the Galilean and Cartesian revolution—which remains, nevertheless, a revolution—had been prepared by a strenuous effort of thought. And there is nothing more interesting, more instructive, nor more thrilling, than to study the history of that effort; to write the story of the human mind dealing obstinately with the same everlasting problems, encountering the same difficulties, struggling untiringly with the same obstacles, and slowly and progressively forging for itself instruments and tools, new concepts, new methods of thinking, which will enable it to overcome them.

It is a long and thrilling story; too long to be told here. Yet, in order to understand the origin, the bearing and the meaning of the Galileo-Cartesian revolution, we cannot dispense with throwing at least a glance backwards, on some of the contemporaries and predecessors of Galileo.

Modern physics studies, in the first line, the motion of ponderous bodies, *i.e.*, the motion of bodies which surround us. Thus it is from the effort to explain the facts and the phenomena of common, everyday, experience—the act of falling, the act of throwing—that proceeds the trend of ideas which leads to the establishment of its fundamental laws. Yet it does not proceed therefrom exclusively, or even principally, or in a direct way. Modern physics does not originate from earth alone. It comes, just as well, from the skies. And it is in the skies that it finds its perfection and end.

This fact, the fact that modern physics has its "prologue" and its "epilogue" in the skies, or, to speak a more sober language, the fact that modern physics takes its origin from the study of

astronomical problems and maintains this tie throughout its history, has a deep meaning, and carries important consequences. It expresses the replacement of the classic and medieval conception of the Cosmos—closed unity of a qualitatively determined and hierarchically well ordered whole in which different parts (heaven and earth) are subject to different laws—by that of the Universe, that is of an open and indefinitely extended entirety of Being, governed and united by the identity of its fundamental laws; it determines the merging of the *Physica coelestis* with *Physica terrestris,* which enables the latter to use and to apply to its problems the methods—the hypothetico-deductive mathematical treatment—developed by the former; it implies the impossibility of establishing and elaborating a terrestrial physics, or, at least, a terrestrial mechanics, without a celestial one; it explains the partial failure of Galileo and Descartes.

Modern physics, which, in my opinion, is born with, and in, the works of Galileo Galilei, looks upon the law of inertial motion as its basic and fundamental law. It does so quite correctly, for *ignorato motu ignoratur natura,* and modern science aims at the explaining of everything by "number, figure, and motion". True, it was Descartes, and not Galileo—as I believe I have established in my illfated *Galilean Studies*[1]—who for the first time fully understood its bearing and its meaning. And yet Newton is not wholly incorrect in giving full credit for it to Galileo. As a matter of fact, though Galileo never explicitly formulated this principle—nor could have—his mechanics, implicitly, is based upon it. And it is only his reluctance to draw, or to admit, the ultimate consequences —or implications—of his own conception of movement, his reluctance to discard completely and radically the experiential data for the theoretical postulate he worked so hard to establish, that prevented him from making the last step on the road which leads from the finite Cosmos of the Greeks to the infinite Universe of the Moderns.

The principle of inertial motion is very simple. It states that a body, left to itself, remains in its state of rest or of motion as long as it is not interfered with by some external force. In other

[1] A. Koyré, *Études Galiléennes,* Paris, 1940.

words, a body at rest will remain eternally at rest unless it is "put in motion". And a body in motion will continue to move, and to persist in its rectilinear uniform motion, as long as nothing prevents it from doing so.[2]

The principle of inertial motion appears to us perfectly clear, plausible, and even, practically, selfevident. It seems to us pretty obvious that a body at rest will remain at rest, *i.e.*, will stay where it is—wherever that may be—and will not move away on its own accord. And that, *converso modo*, once put in motion, it will continue to move, and to move in the same direction and with the same speed, because, as a matter of fact, we do not see any reason nor cause why it should change either. All that appears to us not only plausible, but even natural. Yet it is nothing less than that. In fact, the "evidence" and the "naturalness" which these conceptions and considerations are enjoying are very young: we owe them to Galileo and Descartes, whereas to the Greeks, as well as to the Middle Ages, they would appear as "evidently" false, and even absurd.

This fact can only be explained if we admit—or recognize—that all these "clear" and "simple" notions, which form the basis of modern science, are not "clear" and "simple" *per se et in se*, but only as a part of a certain set of concepts and axioms, apart from which they are not "simple" at all. This, in turn, enables us to understand why the discovery of such simple and easy things as, for instance, the fundamental laws of motion, which today are taught to, and understood by, children, has needed such a tremendous effort—and an effort which often remained unsuccessful—by some of the deepest and mightiest minds ever produced by mankind: they had not to "discover" or to "establish" these simple and evident laws, but to work out and to build up the very framework which made these discoveries possible. They had, to begin with, to reshape and to re-form our intellect itself; to give to it a series of new concepts, to evolve a new approach to being, a new concept of nature, a new concept of science, in other words, a new philosophy.

[2] Sir Isaak Newton, *Philosophiae Naturalis Principia Mathematica;* Axiomata sive leges motus; Lex I: Corpus omne perseverare in statu suo quiescendi vel movendi uniformiter in directum, nisi quatenus a viribus impressis cogitur statum ille mutare.

We are so well acquainted with, or rather so well accustomed to, the concepts and principles which form the basis of modern science, that it is nearly impossible for us to appreciate rightly either the obstacles that had to be overcome for their establishment, or the difficulties that they imply and encompass. The Galilean concept of motion (as well as that of space) seems to us so "natural" that we even believe we have derived it from experience and observation, though, obviously, nobody has ever encountered an inertial motion for the simple reason that such a motion is utterly and absolutely impossible. We are equally well accustomed to the mathematical approach to nature, so well that we are not aware of the boldness of Galileo's statement that "the book of nature is written in geometrical characters", any more than we are conscious of the paradoxical daring of his decision to treat mechanics as mathematics, that is, to substitute for the real, experienced world a world of geometry made real, and to explain the real by the impossible.

In modern science, as well we know, motion is considered as purely geometrical translation from one point to another. Motion, therefore, in no way affects the body which is endowed with it; to be in motion or to be at rest does not make any difference to, or produce a change in, the body whether in motion or at rest. The body, as such, is utterly indifferent to both. Consequently, we are unable to ascribe motion to a determined body considered in itself. A body is only in motion in its relation to some other body, which we assume to be at rest. We can, therefore, ascribe it to the one or to the other of the two bodies, *ad libitum*. All motion is relative.

Just as it does not affect the body which is endowed with it, the motion of a body in no way interferes with other movements that it may execute at the same time. Thus a body may be endowed with any number of motions, which combine to produce a result according to purely geometrical rules; and, *vice versa*, every given motion can be decomposed, according to these same rules, into any number of component ones.

Yet, all this notwithstanding, motion is considered to be a *state*, and rest another state, utterly and absolutely opposed to the former,

so that we must apply a *force* in order to change a state of motion of a given body to that of rest, and *vice versa*.

It is therefore perfectly evident that a body in a state of motion will persist in this state forever; and that it will no more need a force or a cause by which to explain, or to maintain, its uniform, rectilinear movement, than it will need one by which to explain or to maintain its rest.

Thus, in order to appear evident, the principle of inertial motion presupposes (a) the possibility of isolating a given body from all its physical environment, (b) the conception of space which identifies it with the homogeneous, infinite space of Euclidian geometry, and (c) a conception of movement—and of rest—which considers them as *states* and places them on the same ontological level of being.

No wonder that these conceptions appeared pretty difficult to admit—and even to understand—to the contemporaries and predecessors of Galileo; no wonder that to his Aristotelian adversaries the notion of motion as a persistent, substantial relation-state appeared just as abstruse and contradictory as the famous substantial forms of the scholastics appear to us; no wonder that Galileo Galilei had to struggle before he succeeded in forming that conception, and that great, but somewhat lesser, minds, such as Bruno and even Kepler, failed to reach that goal. As a matter of fact, even today, the conception we are describing is by no means easy to grasp, as anyone who ever attempted to teach physics to students who did not learn it at school will certainly testify. Common sense, indeed, is—as it always was—medieval and Aristotelian.

We must now give our attention to the pre-Galilean, chiefly Aristotelian, conception of motion and of space. I will not, of course, endeavor to give here an exposition of Aristotelian physics; I will only point out some of its characteristic features as opposed to the modern; and I would like to stress, because it is fairly widely misappreciated, that the Aristotelian physics is a very thoroughly thought out, and very coherent, body of theoretical knowledge, which, besides having a very deep philosophical

foundation, is, as stated by P. Duhem and P. Tannery,[3] in pretty good accordance—a much better one, indeed, than the Galilean—with the experience, at least with the commonsense experience, of our everyday life.

Aristotelian physics is based on sense-perception, and is therefore decidedly non-mathematical. It refuses to substitute mathematical abstractions for the colorful, qualitatively determined facts of common experience, and it denies the very possibility of a mathematical physics on the ground (a) of the nonconformity of mathematical concepts to the data of sense-experience, (b) of the inability of mathematics to explain quality and to deduce movement. There is no quality, and no motion, in the timeless realm of figure and number.

As for motion—κίνησις—or rather "local motion"—Aristotelian physics considers it a kind of process of change—in contradistinction with *rest,* which, being the goal and the end of motion, is to be recognized as a *state.*[4] Motion is change (actualization or decay) and consequently a body in motion changes not only its *relations* to other bodies, but, at the same time, undergoes itself a processus of change. Motion, therefore, always affects the body which endures it, and, consequently, if a body is endowed with two (or more) movements, these movements interfere with each other, impede each other, and even are, sometimes, incompatible with each other. Besides, Aristotelian physics does not admit the right, nor even the possibility, of identifying the concrete world-space of its well ordered and finite Cosmos with the "space" of geometry, no more than it admits the possibility of isolating a given body from its physical (and Cosmical) environment. In dealing with a concrete physical problem it is, therefore, always necessary to take into account the world order, to consider the realm of being (the "natural place") to which a given body belongs by its nature; and, on the other hand, it is impossible to try to subject these different realms to the same laws, even—and perhaps especially—to the same laws of motion. *E.g., heavy* things descend whereas

[3] P. Duhem, *Le Système du Monde* I (Paris, 1915) 194 sq; P. Tannery, "Galilée et les principes de la Dynamique", *Mémoires scientifiques* VI (Paris, 1926) 399 sq.

[4] For Aristotle rest, being a deficiency, *privatio,* is on a lower ontological level than motion, *actus entis in potentia inquantum est in potentia.*

light ones ascend; terrestrial bodies move in right lines, celestial ones in circles, and so on.

It is evident, even from this brief account, that motion, considered as *processus of change* (and not as *state*), cannot go on spontaneously and automatically, that it requires, for its persistence, a continuous action of a mover or cause, and that it stops dead as soon as this action does not exercise itself upon the body in motion, *i.e.*, as soon as the body in question is separated from its mover. *Cessante causa, cessat effectus.* It follows therefrom, with absolute necessity, that the kind of motion which is postulated by the principle of inertia is utterly and perfectly impossible, and even contradictory.

And now we must come to the facts. I have said already that modern science originated in close connection with astronomy; more precisely, it takes its origin in, and from, the necessity of meeting the *physical* objections formulated by some of the leading scientists of the time against the Copernican astronomy. As a matter of fact, these objections were nothing less than new: quite to the contrary, though presented sometimes in a slightly modernized form, as by replacing the throwing of a stone of the older argument by the firing of a cannon ball, they were fundamentally identical with those that Aristotle and Ptolemy raised against the possibility that the earth moves. It is very interesting, and very instructive, to see them discussed and rediscussed by Copernicus himself, by Bruno, Tycho Brahe, Kepler, and Galileo.[5]

Divested from the imaginative clothing which they gave them, the arguments of Aristotle and Ptolemy can be boiled down to the statement that, if the earth were moving, this movement would affect the phenomena occuring on its surface in two perfectly definite ways: (1) the tremendous velocity of this (rotational) movement would develop a centrifugal force of such a magnitude that all the bodies *not connected* with the earth would fly away, and (2) this same movement would cause all bodies not connected, or temporarily disconnected with it, to lag behind. Therefore, a stone falling from the summit of a tower would never land

[5] Cf. my *Études Galiléennes*, III, *Galilée et le principe d'inertie*, Paris, 1940.

at its foot, and, *a fortiori,* a stone (or a bullet) thrown (or shot) perpendicularly into the air would never fall back to the place from which it departed, because, during the time of its fall or flight, this place would be "quickly removed from below it and rapidly moved away".

We must not smile at this argument. From the point of view of the Aristotelian physics it is perfectly sound. So sound that, on the basis of this physics, it is utterly irrefutable. In order to destroy it we must change the system as a whole and evolve a new concept of movement: The concept of movement of Galileo.

As we have already seen, motion for the Aristotelian is a process which affects the moved, which takes place "in" the body in motion. A falling body moves from A to B, from a certain place, situated above the earth, toward the latter, or, more exactly, towards its center. It follows the straight line which connects these two points. If during this movement the earth revolved around its axis, it would describe, in respect to this line (the line leading from A to the center of the earth) a movement in which neither this line, nor the body which follows it, take any part whatever: the movement of the earth does not affect the body which is separated from it. The fact that the earth beneath it moves away has no effect on its trajectory. The body cannot run after the earth. It follows its path as if nothing happened because, in fact, nothing happened *to it.* Even the fact that the point A (the summit of the tower) did not stay still, but participated in the movement of the earth, does not have any bearing on its motion: what happened to the point of departure of the body (after it left it) has not the slightest influence on its behavior.

This conception may appear strange to us. But it is by no means absurd: it is exactly in that way that we represent ourselves the movement—or propagation—of a ray of light. And it implies that, if the earth were moving, a body thrown from the top of a tower would never fall at its foot; and that a stone, or a cannonball, shot vertically in the air, would never fall back to the place where it went from. It implies, *a fortiori,* that a stone or a ball falling from the top of the mast of a moving ship will never fall at its foot.

What Copernicus himself has to reply to the Aristotelian is very poor. He argues that the unhappy consequences deduced by this

latter would follow, indeed, in the case of a "violent" movement. But not in that of the movement of the earth, and to the things that belong to the earth: for them it is indeed a ***natural*** movement. This is the reason why all these things, clouds, birds, stones, etc., etc., partake in the movement, and do not lag behind.

The arguments of Copernicus are very poor. And yet they bear the seed of a new conception which will be developed by later thinkers. The reasonings of Copernicus apply the laws of "celestial mechanics" to terrestrial phenomena, a step which, at least implicitly, involves abandoning the old, qualitative division of the Cosmos into two different worlds. Besides this, Copernicus explains the *apparently rectilinear* path of the falling body by its participation in the movement of the earth; this movement, being common to the earth, to the body, and to ourselves, remains for us "as if it were non-existent".

The arguments of Copernicus are based on the mythical conception of a "community of nature" between the earth and "earthen" things. Later science will have to replace it by the concept of the physical system, of the system of things sharing the same movement; it will have to rely upon the *physical* and not only upon the *optical* relativity of motion. All of which is impossible on the basis of the Aristotelian philosophy of motion and makes it necessary to adopt another philosophy. As a matter of fact, as we shall see more and more clearly, it is with a philosophical problem that we are dealing in this discussion.

The conception of physical or, rather, mechanical system, which was implicitly present in the arguments of Copernicus, was worked out by Giordano Bruno. By a stroke of genius Bruno saw that it was necessary for the new astronomy to abandon outright the conception of a closed and finite world, and to replace it by that of an open and infinite Universe. This involves the abandonment of the notions of "natural" places and motions as opposed to non-natural, violent ones. In the infinite universe of Bruno, in which the Platonic conception of space as "receptacle" (χώρα) takes the place of the Aristotelian conception of space as envelope, all "places" are perfectly equivalent and therefore perfectly natural for all bodies. Therefore whereas Copernicus distinguishes between the "natural" movement of the earth and the "violent"

movement of the things upon it, Bruno expressly assimilates them. All that happens on the earth if we suppose it in movement has, as he explains, its exact counterpart in what happens on a ship gliding on the surface of the sea; and the movement *of* the earth has no more influence upon the movement *on* the earth than the movement of the ship on those of the things that are in the ship. The consequences deduced by Aristotle would only take place if the origin, *i.e.*, the place of departure, of the moving body were external to, and not connected with, the earth.

Bruno states that the place of origin *as such* does not play any role in the determination of the motion (the path) of the moving body, that what is important is the connection—or lack of connection—of this "place" with the mechanical system. It is even possible—*horribile dictu*—for the selfsame "place" to pertain to two or more systems. Thus, for instance, if we imagine two men, one of them on the top of the mast of a ship passing under a bridge, and the other on that bridge, we may imagine, further, that at a certain moment, the hands of both of them will be in the selfsame place. If, at that moment, each of them shall let a stone fall, the stone of the man on the bridge will fall down (and in the water), but the stone of the man on the mast will follow the movement of the ship, and (describing, relatively to the bridge, a peculiar curve) fall at the foot of the mast. The reason for this different behavior, explains Bruno, is simply the fact that the last stone, having shared the movement of the ship, retains in it a part of the "moving virtue" which has been impressed into it.

As we see, Bruno substitutes for the Aristotelian dynamics the *impetus*-dynamics of the Parisian nominalists. It seems to him that this dynamics provides a sufficient basis for his construction. A belief which, as history has shown us, was an error. It is true that the conception of the *impetus*, virtue, or power, which animates the moving body, produces its motion, and uses itself up in this production, enabled him to refute the arguments of Aristotle; at least some of them. Yet it was not able to meet all of them; still less was it able to carry the structure of modern science.

The arguments of Giordano Bruno appear to us perfectly reasonable. Yet in his time they made no impression whatever; neither on Tycho Brahe, who in his polemics with Rothmann

repeats imperturbably the old Aristotelian objections (though in a somewhat modernized presentation); nor even on Kepler, who, though influenced by Bruno, deems himself obliged to return to those of Copernicus, replacing, indeed, the great astronomer's mythical conception of the community of nature by a physical conception, that of the force of attraction.

Tycho Brahe flatly denies that a bullet falling from the top of the mast of a moving ship will come down at its foot. He affirms that, quite on the contrary, it will lag behind, and lag behind the more the faster the ship is moving. Just as cannonballs, shot vertically in the air, would never—on a moving earth—be able to come back to the cannon.

Tycho Brahe adds that, if the earth were moving, as Copernicus wants it, it would never be possible to send a cannonball to the same distance to the east and to the west: the extremely rapid movement of the earth, if it were shared by the ball, would impede its own movement and even, if the ball had to move in a direction opposite to that of the movement of the earth, render it utterly impossible. The point of view of Tycho Brahe appears to us pretty strange. Yet we must not forget that to him the theories of Bruno seemed utterly unbelievable and even exaggeratedly anthropomorphic. To pretend that two bodies, falling from the same place and going to the same point (the center of the earth), will follow two different paths, describe two different trajectories, for the reason that one of them was associated with the ship, whereas the other was not, means for the Aristotelian to pretend that the bullet in question *remembers* its past association, knows where it has to go, and is endowed with the power and the ability to do so. Which, in turn, implies that it is endowed with a soul.

Besides, as we have already mentioned, from the point of view of the Aristotelian dynamics—as well as from the point of view of the dynamics of the *impetus*—two different movements always impede each other, which is proved by the well known fact that the speedy motion of the bullet (in a horizontal flight) prevents it from moving downwards and enables it to stay in the air much longer than it would be able to do if we simply let it fall to the bottom.

In short, Tycho Brahe does not admit the mutual independence

of motions—nobody did till Galileo; he is therefore perfectly right not to admit the facts, and the theories, which imply it.

The position taken by Kepler is of a quite particular interest and importance. It shows us, better than any other, the ultimate *philosophical* roots of the Galilean revolution. From a purely scientific point of view, Kepler—to whom we owe, *inter alia*, the very term *inertia*—is, undoubtedly, one of the foremost—if not *the* foremost—genius of his time: it is needless to insist upon his outstanding mathematical gifts, equalled only by the intrepidity of his thought. The very title of one of his works, *Physica coelestis*, is a challenge to his contemporaries. And yet, philosophically, he is much nearer to Aristotle and the Middle Ages than to Galileo and Descartes. He still reasons in terms of the Cosmos; for him motion and rest are still opposed as light and darkness, as being and privation of being. Consequently, the term *inertia* means for him the resistance that bodies oppose, not to change of state, as for Newton, but only and solely to movement; therefore, just like Aristotle and the physicists of the Middle Ages, he needs a cause or a force to explain motion, and does not need one to explain rest; just like them, he believes that, separated from the mover, or deprived from the influence of the moving virtue or power, bodies in motion will not continue their movement, but, on the contrary, will immediately stop. Therefore, in order to explain the fact that, on the moving earth, bodies, even if they are not attached to it by material bounds, do not "lag behind", at least *not perceptibly*;[6] that stones thrown upwards come down to the spot they were thrown from; that cannonballs fly (nearly) as far to the west as to the east, he must admit—or find out—a real force which binds them to the earth, and pulls them along.

This force is found by Kepler in the mutual attraction of all material, or at least of all terrestrial, bodies, which means, for all practical purposes, in the attraction of all terrestrial things by the earth. Kepler conceives all these things as bound to the earth by innumerable elastic chains; it is the traction of these chains which explains that clouds, vapors, etc., stones, and bullets, do not stay immobile in the air, but follow the earth in its movement; and the fact that these chains are everywhere explains, in Kepler's opinion,

[6] Cf. *ibid.* 172-94.

the possibility of throwing a stone or firing a cannon *against* its movement: the attracting chains pull the bullet to the East as well as to the West and thus their influence is nearly neutralized. The real movement of the body (the cannonball shot vertically) is, of course, a combination or mixture of (a) its own movement and (b) that of the earth. But, as the latter is common to all the examined cases, it is the former only that counts. It is therefore clear (though Tycho Brahe did not grasp it) that, while the length of the path of a bullet shot to the east and of another shot to the west differ, as measured in the space of the universe, nevertheless their paths on the earth are the same or nearly the same. Which explains why the same force, produced by the same amount of powder, can throw them to the same distance in both directions.

The Aristotelian or Tychonian objections against the movement of the earth are thus satisfactorily disposed of. And Kepler points out that it was an error to assimilate the earth to the moving ship: in fact, the earth "magnetically attracts" the bodies it transports, the ship does not. Therefore, on a ship we need a material bond, which is perfectly useless in the case of the earth.

We need not dwell upon this point any longer: we see that Kepler, the great Kepler, the founder of modern astronomy, the same man who proclaimed the unity of matter in the whole universe and stated that *ubi materia, ibi geometria,* failed to establish the basis of modern physical science for one and only one reason: he still believed that motion is, ontologically, on a higher level of being than rest.

If now, after our brief historical summary, we turn our attention to Galileo Galilei, we shall not be surprised that he, too, discusses at great, and even at a very great, length, the timeworn objections of the Aristotelians. We shall, moreover, be able to appreciate the consummate skill with which, in his *Dialogues on the two greatest world systems,* he marshalls his arguments and prepares for the final assault on Aristotelianism.

Galileo is well aware of the tremendous difficulty of his task. He knows perfectly well that he has to deal with powerful enemies: authority, tradition, and—worst of them all—common sense. It is useless to present proofs to minds not able to grasp their value. Useless, for instance, to explain the difference between

linear and radial velocity (the confusion between which is the whole basis of the first of the Aristotelian and Ptolemaic objections) to people not accustomed to mathematical thinking. You must begin by educating them. You must proceed slowly, step by step, discussing and rediscussing the old and the new arguments; you must present them in various forms; you must multiply examples, invent new and striking ones: the example of the rider throwing his spear in the air and catching it again; the example of the bowman straining his bow more and less and thus giving to the arrow a greater or a lesser *speed;* the example of the bow placed on a moving carriage and able to compensate the *speed* of the carriage by a greater or lesser *speed* given to his arrows. Innumerable other examples which, step by step, lead us, or rather his contemporaries, to the acceptance of this paradoxical, unheard of point of view, according to which motion is something which persists in being *in se et per se* and does not require any cause, or force, for its persistence. A hard task. Because, as I have already said, it is not natural to think of motion in terms of speed and of direction instead of those of effort, of impetus, and of momentum.

But, as a matter of fact, we cannot *think* of motion in terms of effort and impetus: we only can *imagine* in this way. Thus we must choose: either to think or to imagine. To think with Galileo, or to imagine with common sense.

For it is thought, pure unadulterated thought, and not experience or sense-perception, as until then, that gives the basis for the "new science" of Galileo Galilei.

Galileo is perfectly clear about it. Thus discussing the famous example of the ball falling from the top of a mast of a moving ship, Galileo explains at length the principle of the physical relativity of motion, the difference between the motion of the body as relative to the earth, and as relative to the ship, and then, *without making any appeal to experience,* concludes that the motion of the ball, *in relation to the ship,* does not change with the motion of the latter. Moreover, when his empirically minded Aristotelian opponent asks him, "Did you make an experiment?" Galileo proudly declares: "No, and I do not need it, as without any experience I can affirm that it is so, because it cannot be otherwise".

Thus *necesse* determines *esse.* Good physics is made *a priori.* Theory precedes fact. Experience is useless because before any experience we are already in possession of the knowledge we are seeking for. Fundamental laws of motion (and of rest), laws that determine the spatio-temporal behavior of material bodies, are laws of a mathematical nature. Of the same nature as those which govern relations and laws of figures and of numbers. We find and discover them not in Nature, but in ourselves, in our mind, in our memory, as Plato long ago has taught us.

And it is *therefore* that, as Galileo proclaims it to the greatest dismay of the Aristotelian, we are able to give to propositions which describe the "symptoms" of motion strictly and purely mathematical proofs, to develop the language of natural science, to question Nature by mathematically conducted experiments,[6a] and to read the great book of Nature which is "written in geometrical characters".

The book of Nature is written in geometrical characters: the new, Galilean, physics is a geometry of motion, just as the physics of his true master, the *divus Archimedes,* was a geometry of rest.

Geometry of motion, *a priori,* mathematical science of nature. . . . How is it possible? The old, Aristotelian objections against the mathematization of nature by Plato, have they, at last, been disproved and refuted? Not quite. There is, indeed, no quality in the realm of number, and therefore Galileo—as, for the same reason, Descartes—is obliged to renounce it, to renounce the variegated, qualitative world of sense-perception and common experience and to substitute for it the colorless, abstract Archimedian world. And as for motion . . . there is, quite certainly, no motion in numbers. Yet motion—at least the motion of Archimedian bodies in the infinite homogeneous space of the new science—is governed by number. By the *leges et rationes numerorum.*

Motion is subjected to number; that is something which even the greatest of the old Platonists, the superhuman Archimedes

[6a] Experiment—in contradistinction to mere experience—is a question we put to Nature. In order to receive an answer we must formulate it in some definite language. The Galilean revolution can be boiled down to the discovery of that language, to the discovery of the fact that mathematics is the grammar of science. It is this discovery of the rational structure of Nature which gave the *apriori* foundations to the modern *experimental* science and made its constitution possible.

himself, did not know, something which was left to discover to this "marvelous Assayer of Nature", as his pupil and friend Cavallieri calls him, the Platonist Galileo Galilei.

The Platonism of Galileo Galilei (a problem discussed by me elsewhere[7]) is, indeed, quite different from that of the Florentine Academy, just as his mathematical philosophy of nature is different from their neo-pythagorean arithmology. But in the history of philosophy there are more than one Platonic school, more than one Platonic tradition, and it is still a question whether the trend of ideas represented by Iamblichus and Proclus is more or less Platonic than the trend represented by Archimedes.[8]

I will not discuss this problem here. Yet I must point out that for the contemporaries and pupils of Galileo, as well as for Galileo himself, the dividing line between Aristotelianism and Platonism was perfectly clear. In their opinion the opposition between these two philosophies was determined by a different appreciation of mathematics as science, and of its role for the constitution of the science of Nature. According to them, if one sees in mathematics an auxiliary science which deals with abstractions and is, therefore, of a lesser value than sciences dealing with real being, such as physics, if one affirms that physics can and must be built directly on experience and sense-perception, one is an Aristotelian. If, on the contrary, one claims for mathematics a superior value, and a commanding position in the study of things natural, one is a Platonist. Accordingly, for the contemporaries and pupils of Galileo, as well as for Galileo himself, the Galilean science, the Galilean philosophy of Nature, appeared as a return to Plato, a victory of Plato over Aristotle.

I must confess that, to me, this interpretation seems to be perfectly sensible.

ALEXANDRE KOYRÉ

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[7] Cf. my article, "Galileo and Plato", in the *Journal of the History of Ideas*, 1943.

[8] For the whole doxographic tradition Archimedes is a *philosophus platonicus*.

GALILEO'S PHILOSOPHY OF SCIENCE

I

AT THE age of twenty-five—the same number of years after Galileo's death—Isaac Newton already held in his mind the solution of the most conspicuous of all the problems on which he ever speculated: gravitation and the calculus. These two principal achievements of Newton's genius are interconnected because the quantitative interpretation of motion as a universal phenomenon implied the conception of the infinitesimal as a mathematical notion. For the human mind there is no better way to catch and describe a body in motion than the method of fluxions by which the space covered by such a body can be calculated by its velocity at every instant.

Just so the young scientist was bringing to fruition in an analytical way the system of knowledge and the methods of science already inaugurated by Galileo Galilei *more geometrico* and with experimental tests. As a young instructor at the university of Pisa, and also at the same age of twenty-five, Galileo had already made the decisive steps which led to a new science of motion and consequently to a new philosophy of nature. These revolutionary changes in science and philosophy depended on some simple rules concerning the fall of bodies, velocity, acceleration, concussion, and the basic propositions of Galileo's dynamics, rather than on astronomical doctrines and cosmological speculations.

The influence of Tycho Brahe, Copernicus, Kepler, and Giordano Bruno, is scarcely perceptible out of the fields of scientific and philosophical specialization. The new, and universal, course of thought and research characteristic of modern civilization is represented by conceptions and methods pertinent to a branch of science apparently even more limited. This circumstance is explained by the fact that the technical specialization of these elementary notions is merely an aspect of Galileo's basic and universal conceptions of motion, matter, inertia, vacuum, and relativity. The intuitive background and the speculative consequences of these conceptions mark the turn in the evolution of science and thought which separates the modern from the antique and mediaeval minds.

Galileo's youthful achievements do not consist in definitely

formulated statements or in fundamental propositions of a systematic character. The fragments of his first treatise *de motu*, which he brought to a close almost forty years later near the end of his life, show his determination to detach the whole of the phenomena of motion from its more or less latent philosophical and metaphysical background in order to investigate in a limited field of observation and speculation the single as well as the general problems having reference to the subject.

This is the first modern example of an attempt to create and develop a section of natural science as a single discipline of universal value. It was not Galileo's purpose to correct the mistakes and to rectify the conclusions of the doctrines predominating in his epoch. The passionate ardor of the young scientist refused to compromise or to follow the example of his timid and hesitating precursors who always contented themselves with partial solutions in the practical and theoretical fields of physical research.

All these hesitations, contradictions, and perplexities, which brought inextricable confusion into the science of motion or led it to an impasse, depended upon the traditional and general belief of the metaphysical origin and essence of motion as taught by Aristotelian, Platonic, Neoplatonic, and Thomistic philosophy. In this doctrine all the problems connected with phenomena of this kind presuppose an ontological background and religious implications, even when they are tentatively solved with a quantitative method of investigation as promoted by the Occamists of the school of Paris.[1] The divine origin of "natural" motion is stated and confirmed in all the systems of Christian philosophy in evident accord with conceptions and doctrines taught in antiquity.

There is perhaps no other section of philosophy in which an agreement so consistent and lasting is to be found as in the ancient and mediaeval definition of motion. The fundamental propositions of Thomas Aquinas in this respect give a clear idea of the intellectual courage and the degree of emancipation which had to be attained in order to achieve the radical secularization of this section of natural philosophy. According to this doctrine, funda-

[1] On Galileo's precursors and their doctrines of motion cf. A. Koyré, *Études Galiléennes* (3 vols., Paris, 1939) I 7 *et seq.* and *passim*, with critical references to the literature concerning this subject.

mentally uncontradicted, motion had been impressed by the Divine Spirit on the celestial spheres as a quality inherent in the heavenly substance. The ultimate aim of this spherical motion is the "assimilatio ad Deum in causando" and the generation and regulation of all inferior things on behalf of man.[2] In our rigid earthly sphere, however, motion is only a temporary, accidental, "violent" disturbance of a natural order which assigns ceaseless circular motion to the heavenly bodies and to the earth eternal rest.

These few maxims out of the many which determine the scholastic philosophy of nature already reveal the qualitative, finalistic, and metaphysical conception of motion as a fundamental cosmological phenomenon. There is little place left for the discussion of the earthly aspects of motion within this system. A dialectic and deductive chain of arguments can easily harmonize these basic assumptions with the gradation of spiritual and moral values which determines the structure of an orderly and well arranged universe. It has been possible to work out on that basis a more or less coherent philosophy of motion, but never a science of motion.

This is the reason why the precursors of Galileo—the theoretical ones as well as the empirical—always failed to find a common principle which could embrace in a coherent system of knowledge both the qualitative and the quantitative aspects of the problem. Thus the artisans, architects, engineers, and artillerists, of the Renaissance were never able to harmonize their problems and experiences with that philosophy of motion.[3] For the same reason the contemporary astronomers were unable to insert into any framework of classical and Christian cosmology the heliocentric system of Copernicus. Tycho Brahe's negative attitude toward this doctrine and Kepler's hesitations are explained by this fact.[4] The irreconcilable discrepancy between the physical and the metaphysical conception of motion became the crucial problem of the philosophy of nature.

The year 1590 was the climax of this contradictory evolution and one of the most dramatic episodes in the history of ideas. The

[2] *Summa Theol.* I, qu. lxx, art 3; qu. civ, art. 2 etc.; *Contra Gentiles Lib.* III, Cap. xxii etc.; *Liber Sententiarum*, dist. XXXVII, qu. iv (*Solutio* etc.).

[3] For the history of these efforts cf. the author's *Geschichte der neusprachlichen wissenschaftlichen Literatur* (3 Vols.) 1919-1927.

[4] There is an extended literature on this subject. Cf. the concise and acute remarks of A. Koyré, *op. cit.* II 22-44.

intellectual situation at that time is impressively represented by two facts characteristic of the new trends in philosophy and science. In that year Giordano Bruno had already published all his principal works partially devoted to a speculative extension of the Copernican doctrine.[5] In all these works in verse and prose Bruno eludes any definite consideration of the cosmological and physical problems of motion and angrily repudiates every attempt at a quantitative interpretation of natural phenomena. In the same year Galileo had already terminated his preparatory treatise on the theory of motion which reveals a trend of speculation proceeding exactly in the reverse order.[6]

By eliminating one after the other most of the speculative elements of the doctrine of motion, or by treating them in a strictly mathematical way, the young scientist opened to systematic investigation the unlimited physical space in which a privileged form of motion has no sense. In that space every sort of motion is only a function of the "gravity" to which everything in nature is subjected—even fire and air—because gravity is the fundamental cause of motion independent of the shape and the "nature" of the mobile body. In this way celestial mechanics becomes only an aspect of the general rules which explain the fall or swimming of bodies, the inclined plane, and the different forms and variations of motion.[7]

It is on this basis that the heliocentric system was transformed into a problem of mechanics and could be inserted into the framework of a mathematical and experimental science. From now on this fundamental cosmological problem is closely connected with Galileo's speculations on the phenomena of motion wherever they might be measured and observed. In separating these investigations from the doctrines and methods in which the science of motion remained enmeshed up to his time, Galileo surpassed all

[5] Classification and chronology in the author's book on *Giordano Bruno* (Bari 1927) 7 *et seq.*

[6] Galileo Galilei, *Opere* (Edizione Nazionale, 20 Vols., Firenze, 1890-1919) I 251-419. Cf. for this treatise G. Wohlwill, *Galilei und sein Kampf für die Kopernikanische Lehre* (2 Vols. Hamburg-Leipzig, 1909) I 80 *et seq.* and A. Koyré, *loc. cit.*

[7] In spite of his appreciation of Gilbert's theory of magnetism Galileo rejected the force of attraction as a mechanical principle because it reminded him of the concepts of "sympathy" and "antipathy" in the Aristotelian and Scholastic natural philosophy which he consistently opposed.

his precursors in intellectual courage and scientific discernment. He accepted and retained some of the old conceptions,[8] but they appear in his thought totally outside of the scholastic net of philosophical and metaphysical implications. Thereby every step toward the clarification of the phenomena of motion brought the young scientist closer to a physical explanation and justification of the Copernican system.

These were both the scientific and the psychological conditions of Galileo's decision to direct toward the sky the telescope he had constructed especially for that purpose. But in doing so he did not discover merely astronomical facts. He found much more than he had dared to expect. A new universe of immeasurable proportions, and far from human knowledge and imagination, was unfolded before his eyes. The infinite—formerly an attribute of God or the playground of visionary philosophies—stood before his eyes as a physical property of the space which appeared for its part and at the same time as an empirical reality and as a cosmological problem. The solar system turned out to be only a section of a universe of such exorbitant dimensions that all the usual notions of great and small, of above and below, became empty words and revealed themselves to be a source of common errors and misleading nonsense.

Adapting his own mind to such an extensive cosmological vision, he taught his reluctant and amazed contemporaries to conceive of the whole firmament as a tiny, faintly shining body immersed in the immensity of space and to imagine beyond the limits of human sight an innumerable quantity of similar astronomical systems.[9] In the face of the different astronomical phenomena revealed by the telescope, all the hierarchy of nobility, in which a gradation of the cosmological worthiness of the celestial bodies and spheres had been established, vanished as a phantom of senseless imagination and turned out to be a prejudice originated—as Galileo says—by a cowardly human anxiety arising from fear of death.[10]

Moreover, soon after these celestial discoveries Galileo abandoned the ageold conception of a perfect cosmic order and con-

[8] A. Koyré, *op. cit.* I 60 *et seq.*, II 17 *et seq.*, III 47 *et seq.* etc.
[9] *Dialogo dei Massimi Sistemi* etc. (Ediz. Naz.) 392 *et seq.*
[10] *Ibid.* 84.

fessed to a friend his conviction that "God ordered the movements of the celestial spheres with proportions not only incommensurable and irrational but also totally imperceptible to our mind".[11] On that occasion he compared man to an architect who would have distributed the stars in harmonious proportions if he had been induced to construct the celestial vault, "whilst it seems to us that God had scattered them without any rule, symmetry and elegance, just as if He had disseminated them with the hand of chance".

Expressions of this kind prove the disruptive effect of his discoveries on the traditional and official conceptions of an orderly universe as taught and supported by school and church. When the advocate of his opinions in the *Dialogue on the Principal Systems of the World* asserts that the center of the universe is merely an imaginary and nowhere existing point, and when he teaches that there cannot be essential differences of substance and behavior in the heavenly bodies, including our planet, then the representative of the traditional doctrines bursts into the angry assertion that "this way of thinking leads to the subversion of all natural philosophy and stirs up confusion and disruption in heaven, on earth, and in the whole universe".[12]

The opinion of this fictitious personage is, of course, nothing else than Galileo's own conviction. At the beginning of his career he had recognized that his conception of motion and space was irreconcilable with the Aristotelian and, implicitly, the Platonic and Scholastic philosophy of nature.[13] In the fulness of his years and experiences he denied any possibility of a compromise between his cosmological vision and the doctrines of those schools and traditions. It has been reserved to some of our contemporaries to label Galileo as a Paduan Aristotelian or as a Platonist, and even to stress the influence of Neoplatonism on his conceptions of nature.[14] In reality his fundamental conceptions of motion and matter, of geometry and relativity, are just so many radical steps which took the new philosophy of science and nature definitely

[11] Cf. Galileo's letter to G. Gallanzoni of July 16, 1611 (Ediz. Naz. XI 149).
[12] Ed. Naz. VII 62.
[13] Cf. the fragments of the treatise *De Motu*, Ed. Naz. I. Plato's conception of motion is identical with the Aristotelian.
[14] Cf. the author's article on "The Scientific Personality of Galileo" in *Bulletin of the History of Medicine*" XII (1942) 248-273.

out of the traditional schemes of thinking and obsolete methods of investigation.

Some fossil material collected from the last ramifications of scholasticism will never restore to Aristotle the paternity of modern science.[15] The part taken by authentic Platonism in the formation of Galileo's thought is represented by his attempt to imagine an ideal abstract reality ruled by mathematical conceptions.[16] But his method of systematically objectifying natural phenomena through physical experiments and astronomical observations transformed that speculative image of the world into a functional, concrete, and measurable reality which is far beyond the Platonic influence and no longer a derivative of Platonic doctrines.[17] The abstract sphere of absolute validity of his laws of motion is no longer the Platonic ideal world but the physical vacuum, just as Galileo's conception of geometry as being homogeneous with the unalterable matter runs counter to the most elementary principles of Plato's ontological and cosmological system.[18]

There is little left, indeed, of these doctrines in Galileo's natural philosophy based on the conviction of an universe physically homogeneous and developed into a science of quantities and relations. The epistemological value of mechanics had never been anticipated, much less proclaimed and taught, by any one of his

[15] The recent attempts to connect Galileo's conceptions with the Aristotelian traditions of thought and school show little understanding of the essential achievements of Galileo's science and philosophy. In an article devoted to "Milieu and Ambiance" published in *Philosophy and Phenomenological Research*, III (1942) 1-42, Professor Leo Spitzer of the Johns Hopkins University tried to show that "there is a filiation leading from Aristotle's περιέχον through the medieval and Renaissance translations to Italian *ambiente*" first used by Galileo for the designation of the "space as a container" etc. In reality this term never appears in medieval philosophical and scientific texts or translations. It was evidently coined by Galileo as a dynamic substitute for the Aristotelian designation of space and medium as a περιέχον, a term which implies rest just as *ambiente* implies motion. The history of the word *momentum* as a dynamic counterpart of Aristotle's concept of ῥοπή offers a characteristic example of similar terminological substitutes determined by new physical conceptions. (Cf. the writer's book on *Galilei und seine Zeit* (Halle, 1927) 251-255).

[16] On the Platonic elements and trends in Galileo's thought cf. *ibidem* 164-166.

[17] A. Koyré's conclusions about Galileo's Platonism (*op. cit.*, especially III 267 *et seq.*) do not take into consideration this important restriction and consequently overrate Plato's influence on the origin of modern science. It is impossible to harmonize Galileo's fundamental conception of motion with Plato's cosmology and natural philosophy.

[18] This opinion is discussed in the *Dialogo dei Massimi Sistemi* etc. Ed. Naz. VII 232 *et seq.*

precursors.[19] It would have been denied and opposed by all the schools of philosophy represented in Galileo's era and no less by the most daring and independent spirits who—like Nicolaus Cusanus, Copernicus, or Giordano Bruno—never abandoned the traditional conception of motion. A dialectical compromise or a syncretistic fusion of doctrines like those so frequently attempted in the Middle Ages and the Renaissance was out of the question after Galileo's determination to make the laws of dynamics the starting point of a new philosophy of nature. He knew of Giordano Bruno's failure in adapting, in a merely speculative way, the Copernican system to the emanative doctrines of neoplatonic inspiration, and in attempting to substitute for peripatetic schemes of logic the threadbare artifices of the Lullian thinking machine.[20] He had been warned by different kinds of dialectical tricks which serve—as he says—to accommodate the facts to a preconceived purpose instead of accommodating the purposes to the facts as established.[21]

Thus Galileo's attitude toward the fundamental problems of natural philosophy does not reveal hesitations or contradictions. He started with a decided purpose to ban all metaphysical interferences and philosophical implications from his investigation of mechanical phenomena. He kept the same attitude after his celestial discoveries. To Thomas Campanella, who could not understand this apparent selfmutilation of philosophy, Galileo simply answered that "it is more estimable to find out the truth, even in an insignificant detail, than to speculate extensively on the highest problems without a positive and definite result".[22] His precise historical position is to be explained, not by associating his thought and work with doctrines and methods of the past, but by compar-

[19] This can be said also of Archimedes, considered by Galileo as his principal master (Ed. Naz. XIX 645). Although the famous sentence "Give me a point of support and I will lift the world" can be interpreted as the first outlook toward a cosmic extension of mechanical principles, Archimedes never abandoned the static concept of equilibrium. Therefore Koyré's interpretation of Galileo as a Platonist with an Archimedean trend of thought (*op. cit.* I 69 *et seq.* and *passim*) does not consider the essential differences resulting from the new, and fundamental, dynamic and kinematic interpretation of physical phenomena.

[20] Cf. the book on Giordano Bruno quoted above (n. 5) 57 *et seq.* and 99 *et seq.*

[21] *Dialogo dei Massimi Sistemi* etc. Ed. Naz. VII 96 and 120.

[22] Ed. Naz. IV 738.

ing the intellectual attitudes towards science and philosophy predominating in his era with those which grow out of his specific problems and of his scientific insight.

II

For the first time in the history of science some mechanical problems of cosmic validity appeared entirely separate from a system of learning and philosophy. None of Galileo's precursors conceived of the mechanical problems they fruitlessly tried to solve as principles of universal validity which could explain natural phenomena in the heavens with the same evidence and cogency as those on earth. It was a new and bold conviction, indeed, that a physical experiment, or a small number of relations, proportions, and definitions expressed in mathematical language, would be able to reveal and to explain the phenomena occurring in the infinite variety of nature and the unlimited extension of the universe. The epistemological and methodical justification of this uncompromising, disruptive, and ambitious "new science" was a new and difficult intellectual problem for a generation accustomed to accept or to discuss the most different aspects of natural philosophy within the closed system of Aristotelian categories of classification or within the more flexible framework of the Platonic and emanatist doctrines.

The simple theoretical acceptance of the quantitative, experimental, relativistic way of thinking and investigating obliterated the basic principles of their fundamental conceptions and conclusions. Hence this new science had no authority, support, or confirmation, other than the logical necessity of its mathematical demonstrations and the concrete evidence of its experimental tests. There was no possibility of connecting this method of natural investigation with the deductive, distinctive, dialectical, and analogical procedure which made the Aristotelian system of knowledge an almost gapless texture of orderly cognitions.

Thus Galileo's physical, astronomical, and cosmological doctrines appeared isolated in their own intellectual sphere and suspended in a sort of intellectual vacuum. The new science taught on the one hand some attested facts and a new method for the solution of natural problems; on the other hand it revealed the

immeasurable extent of human ignorance and the customary source of millenary errors. By that process Galileo brought his contemporaries, in so far as they were thinking beings, into an unexpected and entirely new intellectual situation. All the knowledge that seemed to have been an almost definitive possession of the human mind was presented now as the far goal of a long and hard intellectual conquest. Galileo taught and warned his contemporaries not to think of natural philosophy in Aristotelian, Peripatetic, Platonic, or Scholastic terms or in the way followed by the philosophers of the Renaissance. But he could not settle into a merely negative attitude while teaching a science of universal extension. He had to substitute for the old schemes of thinking a method equivalent at least both in demonstrative force and in extensive comprehension. We ought, therefore, to discover what was his opinion about the significance and goal of a science which, though so limited and fragmentary, dared to replace the most complete and comprehensive systems of human knowledge.

Galileo's repeated and emphatical assertion that "the whole of philosophy is understood only by God"[23] does not entitle the historian of his thought to qualify him as an agnostic or a sceptic. In spite of these sincere and devout expressions of humility and caution, he undoubtedly aimed at a final understanding of the structure of the world, a problem he admitted to be the most noble in nature and science.[24] An expression like this reveals that he knew what no productive and introspective scientist or scholar ever forgets; namely, that a single statement, an isolated detail, a specialized research, an individual scientific conclusion, takes on significance only if it participates in a general truth of universal value. Without this conviction, and when detached from this universal background, research is merely an idle trouble and a mental sport, or—as Galileo put it—a source of "sagacious inventions for the delight of ingenious spirits".[25]

Apparently his system of science seemed to be without any philosophical foundation and comprehensive outlook. Descartes

[23] Ed. Naz. III 398.
[24] *Dialogo dei Massimi Sistemi* etc. Ed. Naz. VII 398.
[25] Preface to the *Dialogo* etc. Ed. Naz. VII 29. This preface was inspired, and even, in part, written, by Pater Riccardi who wanted to protect his friend from an indictment of the inquisition.

reproached him with having sought only "the reasons of some particular phenomena" and of having "built without a foundation".[26] The French philosopher reveals by the terms of his critical judgments that he was less emancipated from the traditional ways of thinking than the Italian scientist. Galileo was convinced that he had founded a new philosophy in which the extension and quantity of the initial knowledge was irrelevant. He aspired to the intensity and the stringent evidence of some basic notions supported and developed by the conclusive proceedings of his new methods of science. These notions ought to have the absolute intuitive and demonstrative certitude of mathematical propositions and the forceful evidence of repeatedly tested experiments.[27] In his own words, he hoped his discoveries and doctrines "might serve to tune some pipes of this great but discordant organ which our philosophy is, on which many organists seem to take great pains to the end of reaching a perfect concord; but they do it in vain, because they leave and keep out of tune three or four of the principal pipes to which it is consequently impossible to tune the rest in perfect harmony."[28]

The principal aim of the new methods of science is to restore the philosophical harmony of the human mind by means of a few well tuned fundamental principles of a cogent and simple evidence. One of these few general ideas on which his whole system of science stands is his assumption "that matter is unalterable, *i.e.*, always the same, and that because of its eternal and necessary character it is possible to produce demonstrations of it no less straight and neat than those of mathematics".[29] The ubiquity of matter determines the universal validity of this basic principle of Galileo's natural philosophy, just as the unalterable character of matter justifies, and even requires, mathematical procedure in the interpretation of natural phenomena. Matter and mathematics are

[26] Cf. the letter to P. Mersenne in Ed. Naz. XVII 287 *et seq.*

[27] There is no reason to underrate the importance of the experiments in Galileo's doctrines and achievements. If his contemporaries found that his experiments did not work (cf. A. Koyré, *op. cit.* 74) it must be admitted that Galileo had in this field more routine and technical skill than his imitators.

[28] Letter to Mark Welser, May 4, 1612, Ed. Naz. V 113.

[29] *Discorsi e Dimostrazioni Matematiche intorno a due Nuove Scienze* (Ed. Naz. VIII 51) and the corresponding passage of the English translation of H. Crew and A. de Salvio, New York 1914 and Evanston, Ill., 1940.

mutually interdependent. One of the conclusions reached in one of the fields is valid and cogent also for the other. This is not so much the starting point for a "mathesis universalis" as it is the theoretical foundation of an experimental science which reduces human thought and physical experience to the necessary cogency of mathematical conclusions.

In this way Galileo inaugurated, together with physical science, the physical method of thinking which is congruent to but not identical with mathematical thinking. The few but sure propositions of his mechanics were the points of departure for a new intellectual conquest of the world. In place of a closed system of natural philosophy as represented by the traditional doctrines he offered an outlook with unlimited intellectual expansion, and for the old static image of the world he substituted a new dynamic vision of a steady scientific development.[30] This vision is supported by the eternal belief that God reveals Himself in the majesty of nature. But Galileo believed that God reveals Himself also in our human mind. The privilege of reading in the great book of nature is granted to man on condition that he spell out the mathematical letters in which it is written.[31] Its proper and infallible language excludes the insidious fallacies of the common human tongues and the figurative interpretation of phenomena. It helps to avoid the misunderstandings derived from false analogies, and makes impossible all the wrong conclusions which depend on alogical inferences and the metaphorical sense of words.

To the apparent and delusive knowledge of the traditional philosophies he opposes the intuitive, inexorable, and transparent veracity of the physical principles and methods which are so evident and universal that within their spheres there can be no difference of opinion among men, nor a breach of understanding between man and God. In fact—he says in memorable terms—if taken *extensively* human knowledge is like nothing in comparison with the infinite divine intelligence; but *as to the intensity* of the propositions acquired by the human mind with the mathematical

[30] Galileo gave different but coherent expression to this idea. Cf. Ed. Naz. V 309; VIII 56, 131, and 136; XII 359 *et seq.* etc. It is mainly in his *Saggiatore* (Ed. Naz. VI) that Galileo illustrated extensively the contrast between the progressive nature of his science and the conservative character of the traditional doctrines.

[31] *Il Saggiatore, loc. cit.* 232

method of thinking there can be no gradation of their objective and necessary certitude. In this field of knowledge the human mind coincides with the divine wisdom with a mere difference of time because the knowledge gradually attained by the investigating human intellect is always omnipresent in the mind of God.[32]

The philosophical consequences and the epistemological implications of this daring and sublime thought are unequivocal and inescapable. It was far from Galileo's intention to put in question the transcendence of the divine mind; but he was convinced of the divinity of human intelligence. Some of the philosophers of the Renaissance went so far as to believe that there was affinity and congeniality between the divine and the human mind.[33] The relationship between both is an old and perhaps inexhaustible religious and theological problem. But nobody had ever presumed to attest their identity within the sphere of a measuring, counting, and weighing science. This objective, impersonal science, proceeding along the track of mathematical conclusions, is able to some extent to attain the absolute divine certainty which was formerly granted only to a few favored seers in an instant of silent mystical rapture. The penetration of the divine mind and the contemplation of the wonders of nature are now possible to all of God's creatures who can adapt their minds to the methods and conclusions of a correct scientific way of thinking.

Although an autonomous creation of the human intellect, by virtue of its divine aim and support science cannot remain isolated in its own field of selfsufficient knowledge. Philosophy, cosmology, theology, and metaphysics cannot overlook the achievements of a science so absolute in its methods and results that it does not admit within its sphere any contradiction between human and divine knowledge. It was from this theoretical and philosophical conviction that Galileo drew the impulse, the courage, and the tenacity, for challenging both the representatives of the official scientific doctrines in schools and the guardians of religious orthodoxy in the ecclesiastical institutions, to face the new spiritual situation following from the incontestable acquisitions of a new science and his discoveries in the sky. Thus he set out to convince his

[32] *Dialogo dei Massimi Sistemi* etc. Ed. Naz. VII 128-130.
[33] Cf. W. Dress, *Mystik des Marsilio Ficino* (Berlin, 1929) 82 *et seq.*

generation of the priority and supremacy of scientific conclusions over all the contradictory results of the speculative and dialectic schools and methods of philosophy and also in cases where contradictions might be found between the two forms of divine revelation, *i.e.*, between the word of God in the Scriptures and the laws of nature in science.[34] Words, he says, even if inspired by God, are ambiguous because they are subject to the limited power of common human comprehension; on the contrary, the inexorable and immutable laws of nature are unequivocal and exactly the same both for divine and human understanding. He firmly believed that even the smallest truth acquired by the human intellect with the methods of science participates in the universal wisdom of God.

It is from this point of view that Galileo insistently asked for a thorough revision of the doctrines then predominating in schools and in general European culture. Simultaneously he warned the theologians not to stick at the words of the Scriptures when they seem to contradict the results of cogent demonstrations and scientific experiments. The time will come—he said—when it would be heretical to say that the earth stands still and the sun moves, *i.e.*, just the contrary of the opinion that they were defending with all the weight of their authority.[35] He was convinced that God's knowledge is infinite times infinite;[36] but he believed in the unlimited progress of science in revealing the secrets of nature with a godlike certitude. "Science can only advance", says the representative of his doctrines in the *Dialogue on the Principal Systems of the World.*[37] And Galileo himself asked emphatically: "Who wants to put limits to the human mind?"[38]

[34] This idea is extensively explained in the Letter to the Grand Duchess Cristina (1615) Ediz. Naz. V 307 *et seq.* Galileo never used the term physical or natural "law", which was familiar to Kepler, Descartes, and Newton (cf. E. Zilsel, "The Genesis of the Concept of Physical Law" in this REVIEW LI (1942) 245-279). But Leonardo da Vinci already speaks of "la natura costretta dalla ragione della sua legge che in lei infisamente vive" (*Les Manuscrits de L.d.V. etc. publiés par Ch. Ravaisson Mollien* (Paris, 1888) Vol. III, fol. 23 § 7 [MS C]), and Galileo used the synonym "decreti della natura" (Ed. Naz. IV 81) in a stronger and more personal sense.

[35] Ed. Naz. VII 541 (preparatory notes to the "Dialogue on the Principal Systems of the World").

[36] *Ibid.* 198.

[37] *Ibid.* 62. It is in his *Saggiatore* (Ed. Naz. VI 236 *et seq.*) that Galileo expressed the belief that science will be more perfect when the number of its fundamental conclusions is less.

[38] Letter to the Grand Duchess Cristina, Ed. Naz. V 128.

That the truth ripens with time had been a vague feeling since antiquity: *Veritas Filia Temporis.*[39] But this beautiful device took on a new significance when Galileo substituted for the extensive growth of human knowledge the methods of an intensive and progressive science of nature. He knew that one truth draws the next after it, but at the same time he felt that every truth discovered by natural science is a starting point for new speculations and the key to unexpected mysteries. For Galileo science is as unlimited as its object. But every new conclusion attained with its methods represents a new approach of the human to the divine intellect: *Veritas Filia Aeternitatis.*

The human mind is a part of the divine mind, just as our solar system is a part of the infinite universe. The limits exist only in our understanding, which increases with every conquest of an intensive and infallible science. Consequently no mediator is needed for our cognition of the divine intelligence as soon as we possess the tools supplied by this progressive science. For Galileo metaphysics does not lie beyond physics because physics is a part of metaphysics. Thus theology and natural science have, though their fields and methods are different, an identical goal. On the basis of its unshakable objective principles and with this metaphysical support his rational and empirical natural science became identical with natural philosophy. By its very definition this philosophy does not concern itself with ontological questions. It does not consider being but that which comes to pass. Its interest is directed toward the circumstances and conditions in which a natural phenomenon occurs; but it excludes as totally superfluous inquiries into the essence of things. This philosophy makes nature an object of divine contemplation and human investigation with a mere difference of time as to the essential and necessary results. In the knowledge of the immutable and inexorable laws of nature the divine and the human mind meet in an intimate union which cannot be attained by other means or in a different field of knowledge.

The first implication of Galileo's philosophy of science is a clear separation of science from religion with the effect of securing their

[39] Cf. the author's book on *Galilei und seine Zeit* 279-280 and F. Saxl in *Philosophy and History* (Essays presented to E. Cassirer, ed. by R. Klibansky and H. J. Paton, Oxford, 1936) 197-222.

coexistence without conflicts of conscience or contradictions in maxims and doctrines. Science has a preeminence in questions concerning the human knowledge of nature, religion in matters of human salvation. If this respective autonomy is mutually accepted there can never be an heretical conclusion in a natural philosophy which is based on irrefragable principles and whose methods lead to a godlike understanding of the universe. Nor can religion hamper the fated advancement of human knowledge.[40]

The traditional science gave a finite image of the universe with some lacunae to be filled in by assiduous collecting of facts, by schemes of logic, or by commonsense evidence. The new science, on the contrary, starting from a personal intellectual experience, proved to be an endless puzzle with some reliable rules for its solution, but without a pattern for its final completion. Galileo's science is conceived as a perennial philosophy of a progressive and dynamic character, as a slow but steady intellectual conquest of the universe. It was the conviction of an intimate, even if partial, conformity of the human and the divine mind that gave this fragmentary and inexhaustible science its moral value and the certainty of its ultimate perfection.

The metaphysical implications of Galileo's philosophy of science exclude every attempt at a pantheistic interpretation of nature. On the other hand the same fundamental assumption frustrates the long effort of the philosophers of the Italian Renaissance from Ficino to Bruno, who sought the solution of the essential problems of natural philosophy in the framework of Platonic doctrines or in the schemes of neoplatonic emanatism.[41] Likewise, Galileo's speculations about motion prove that he did not intend to dissolve the entire philosophy of nature into a sort of universal mathematics and to reduce the structure of the universe to a pure geometrical system. He was far from renewing the conception of God as the divine Geometer which Pascal rejected as a pagan philosophical myth. But inevitably this selfassured, inquisitive, and aggressive science, which pretended to attain a godlike know-

[40] This is one of the principal conclusions of the Letter to the Grand Duchess Cristina.

[41] This doctrine determined many characteristic aspects of the Italian civilization of the Renaissance, but there is no trace of it in Galileo's thought.

ledge and a sort of preeminence over all other doctrines, profane as well as divine, would clash with dogmas and philosophies inspired by a divine revelation. A formal juridical procedure invoked by Pope Urban VIII seemed sufficient to wipe out a doctrine which dared to limit and constrain the power and wisdom of God within the narrow district of human understanding.[42]

Its final condemnation did not intend to destroy Galileo's new science of motion but to suppress its necessary implications, both cosmological and philosophical. But this discriminating differentiation of science and philosophy turned out to be a dangerous and even fatal delusion. This authoritative reaction against the intellectual hegemony of a natural philosophy based on physico-mathematical methods of investigation deprived the new science of its philosophical support and of its metaphysical "raison d'être". Pushed back into the boundaries of a technical discipline, this powerful instrument of knowledge became a tool in the hands of the *homo faber* as a source of "sagacious inventions for the delight of ingenious spirits". The technical specialization of science led to the spiritual isolation of the human genius. Seen from this angle the divine aspiration of Galileo is not merely an episode in the history of science and philosophy. Now more than ever it appears to be the condition for the success of human efforts in the secular struggle for scientific enlightenment.

LEONARDO OLSCHKI

[42] Cf. E. Cassirer, "Wahrheitsbegriff und Wahrheitsproblem bei Galilei" in *Scientia* LXII (1937) 121 *et seq.* and 185 *et seq.*

NEWTON AND LEIBNIZ

THE controversy between Newton and Leibniz is one of the most important phenomena in the history of modern thought. If we follow this controversy step by step, if we study the correspondence between Leibniz and Clarke, who acted as spokesman for Newton, we are immediately aware that much more was at stake than the particular physical and metaphysical questions which are explicitly treated by the two adversaries. Newton and Leibniz disagreed not merely as to the solution of these questions. They not only had different views on the nature and properties of God, on the structure of the material universe, the concepts of space and time, and the possibility of an *"action at a distance"*. However important all these questions may be, they have here only a mediate and subordinate significance. They are overshadowed by another problem which was of vital interest for the future development of scientific and philosophic thought. Modern thought had reached a parting of the ways where it had to choose between two alternatives. In the dispute between Newton and Leibniz these alternatives were clearly indicated. The two opposing theses were represented and defended by two powerful and original thinkers who stood without a rival in contemporary science or philosophy.[1] This is not, therefore, a mere scholastic disputation. For behind the catchwords of the two schools of thought we feel the clash and trial of strength of two great intellectual forces. Nor is this simply a controversy between individual thinkers; it is rather a collision between two fundamental philosophical methods. And it is this feature of the dispute which makes it important and interesting even for the present-day reader.

Perusal of the various papers which passed between Leibniz and Clarke in the years 1715 and 1716[2] does not suffice for an understanding of the full meaning and purport of this polemic. At first such a perusal is very disappointing. Both sides repeat the

[1] The full authenticity of the Clarke papers is proved by the fact that the outlines of Clarke's replies have been found among Newton's manuscripts.

[2] In the following I refer to the English edition published after Leibniz' death: *A Collection of Papers which Passed Between the Late Learned Mr. Leibniz and Dr. Clarke in the Years 1715 and 1716. Relating to the Principles of Natural Philosophy and Religion.* By Samuel Clarke, London 1717.

same arguments over and over again until interaction between their views seems impossible. For each party obstinately holds its ground refusing to enter into his opponent's views. Moreover, from the outset the controversy was obscured by personal invective. Each side accused the other of undermining the foundations of natural religion. The more the discussion proceeded the more this tone of arguing and reasoning tended to prevail. Yet this was natural and unavoidable. For Samuel Clarke, who pleaded for Newton, was neither a scientist nor a philosopher. He was one of the best known theological controversialists of his time. In his book *A Demonstration of the Being and Attributes of God* he had undertaken to demonstrate the existence of God and all the other fundamental truths of the Christian religion by merely logical arguments and to answer all the objections of the "free thinkers", the sceptics, the deists, and atheists.[3] This book became so famous that Voltaire could not forbear paying his respects to its author. In his *Lettres sur les Anglais* Voltaire spoke of Clarke as "a veritable reasoning machine" (une vraie machine à raisonnements).[4] And there were still other factors tending to obscure the point at issue. The old dispute between Newton and Leibniz about the priority of the invention of the infinitesimal calculus was not forgotten. Personal ambitions and jealousies, even national prejudices, began to awake again. For us this side of the question has lost its interest. After the most careful historical investigations this point seems now to be entirely cleared up.[5] We know that both Leibniz and Newton, on the basis of independent considerations, had come to the same results; we know that each method, the method of fluxions and that of the differential and integral calculus, has its peculiar character and its peculiar merit. "From the point of view of the history of ideas"—it has been rightly said—"there exists no controversy in the annals of science more de-

[3] The full title of the book is: *A Demonstration of the Being and Attributes of God, the Obligations of Natural Religion and the Truth and Certainty of the Christian Revelation, More Particularly in Answer to Mr. Hobbs, Spinoza and their Followers.* London 1705/1706.

[4] Voltaire, *Lettres sur les Anglais,* VII, in *Oeuvres,* Paris 1821, chez Lequien, XXVI 33 ff.

[5] For the history of this controversy I refer to Moritz Cantor, *Vorlesungen über die Geschichte der Mathematik* III (Leipzig 1898) 274-316; and to David Brewster, *Memoirs of the Life, Writings, and Discoveries of Sir Isaac Newton,* Edinburgh, 1855, vol. II, chap. xv, pp. 36-83.

plorable and less fertile than this discussion of the priority of the invention of the infinitesimal calculus. It is remarkable that this famous dispute which originated under quite accidental circumstances did not affect or modify in any respect the ideas of the two adversaries or the philosophical tendencies of their pupils. It would be difficult to show that a single step of progress was made by this controversy over the new conceptions of the infinite and the infinitely small. As a result of this conflict the English school and the German school of thought deprived themselves for a long time of all the advantages which they might have derived from united efforts. The quarrel between Newton and Leibniz, founded upon mere personal rivalries, left the two philosophical methods stationary. The detailed study of this quarrel supplies us in the main with interesting observations concerning the psychology of Leibniz, of Newton, and of other eminent scholars of their time. But it gives us very little information about the distinctive features of the Leibnizian and Newtonian systems."[6]

In order to discover these distinctive features we must, indeed, try a different approach. We must endeavor to trace back the dispute between Leibniz and Newton to its real source, and to look behind the scenes of the great intellectual spectacle presented here. In this case we shall find that the ideas propounded and defended by these two adversaries have by no means lost their value and interest. These ideas are still alive, and, to a certain extent, they are still in the focus of modern philosophical and scientific thought —even though we may, indeed we must, express them in a different manner. There was no real dissension between Leibniz and Newton about the fundamental problem: the validity and necessity of a mathematical science of nature. We may call Newton a "physicist", and Leibniz a "metaphysician"; but Leibniz himself would never have subscribed to such a distinction between mathematical and metaphysical thought, for he admitted no chasm here. Whenever he mentioned his metaphysics he described it as a "metaphysic of mathematics". "Ma Métaphysique", he wrote in a letter, "est toute mathématique".[7]

[6] Léon Bloch, *La Philosophie de Newton* (Paris 1908) 115 f.
[7] Leibniz, Letter to de L'Hospital, December 27, 1694. See *Leibnizens mathematische Schriften* (ed. C. I. Gerhardt, Halle 1849 ff.) II 258.

It would be a more correct statement of our problem to say that Leibniz defends a *"deductive"* ideal of scientific thought whereas Newton speaks as the champion of an empirical, a merely *"inductive"* method. But even this distinction would be misleading in many respects. "Induction" and "deduction" are rather vague terms. They have been used in various and widely divergent senses. If we understand the ideal of induction in the sense of Bacon's *Novum Organum*, or of some more recent logicians, as, for instance, John Stuart Mill, then we must say that Newton never recommended or defended a strictly "inductive" method. The method introduced by Newton was of a quite different type. What in Bacon's aphorisms had only been dreamed of seemed suddenly to have become a reality. Newton's first pupils revered him not merely as one of the greatest scientists of all time. They saw in him the very incarnation of the philosophic spirit because he was the first to understand what a *philosophy* of nature really is and means. John Friend, an Oxford professor of Chemistry, who in his *Praelectiones Chymicae* was one of the first to try to apply the Newtonian principles of mechanics to chemical problems, spoke of Newton as the "prince of mathematicians and philosophers". "By his excellent genius", he said, "he has taught us a sure way for the improvement of physics and has fixed natural knowledge on such weighty reasons that he has done more to illustrate and to explain it than all philosophers of all nations."[8] Friend declared that Newton's conclusions in philosophy are as demonstrative as his discoveries are surprising.[9] "It has been ignorantly objected by some", wrote another of Newton's disciples, "that the Newtonian philosophy, like all others before it, will grow old and out of date and be succeeded by a new system. . . . But this objection is very foolishly made. For never a philosopher before Newton ever took the method he did. For whilst their systems are nothing but hypotheses, conceits, fictions, conjectures and romances invented at pleasure and without any foundation in

[8] John Friend, in his remarks upon an account of his *Praelectiones Chymicae*, given in the *Acta Eruditorum*, 1711.—See *Philosophical Transactions*, abridged and disposed under General Heads, V 429 sq.

[9] See the English edition of his *Praelectiones Chymicae. Chymical lectures: in which almost all the operations of Chymistry are reduced to their true principles and the laws of nature*, London 1712, Appendix, 174.

the nature of things, he, on the contrary, and by himself alone, set out upon a quite different footing. . . . The foundation is now firmly laid: the Newtonian method may indeed be improved, and further advanced, but it can never be overthrown."[10]

But what was the true character of this method? By which fundamental feature is it to be distinguished from that other ideal of "induction" which is represented in Bacon's method of "positive and negative instances"? To answer this question historically we may say that Newton in his *Principia* carried on and brought to completion the work of Galileo, not the work of Bacon. There is a fundamental difference between Galileo's and Bacon's conception of a true inductive method.[11] Even Bacon was striving for a "rational" method of science. He was an empiricist but no sensationalist. He has described his aim in a short and characteristic formula by saying that his *Novum Organum* was composed with the intention of putting an end to all those unfortunate conflicts and dissensions which hitherto had disturbed the human family; and to establish, for all time, a firm and legitimate matrimony between the empirical and the rational faculties of the human mind.[12] But the Baconian ideal was an ideal of extension and amplification, whereas the ideal of Galileo and Newton is one of intension and simplification. Bacon hoped to attain his end, he hoped to promote and secure the "advancement of learning", by steadily and incessantly increasing the bulk of our empirical evidence. If we collect and compare all the available data we shall be in a position to disclose and isolate the "pure forms" of things. Newton imposed a different task upon science. As a physicist he was not investigating these substantial forms—the form of heat or the "essence" of gravity. He wished to reduce the phenomena of nature to general laws and to derive these laws from mathematical principles.[13] For this purpose the accumulative and comparative process of the Baconian induction had to be turned into an analytical process. Without the latter all our empirical evidence would remain sterile; it could not bear its fruit. In all the different

[10] William Emerson, *The Principles of Mechanics* (London 1773) v ff.

[11] Concerning this question I refer to my remarks in a recent article on Galileo, published in *The American Scholar* (January 1943) XII 5-19.

[12] See Bacon, *Novum Organum*, Praefatio.—*Works*, ed. by Ellis, Spedding, and Heath, London 1857 ff., I, 131.

[13] *Cf. Opticks*, Book III, part i; *Principia*, Preface to the first edition.

fields of physical inquiry Newton always insisted upon this character of his "analytical induction". "As in Mathematics, so in Natural Philosophy", he said in his *Opticks,* "the investigation of difficult things by the Method of Analysis, ought ever to precede the Method of Composition. . . . In the two first books of these Opticks, I proceeded by this analysis to discover and prove the original differences of the rays of light in respect of refrangibility, reflexibility and colours. . . . And these discoveries being proved, they may be assumed in the method of composition for explaining the phenomena arising from them."[14]

Newton did not arrive at his principal theories by simply collecting new facts. Most of the empirical evidence he needed for constructing his optical theories or his theory of gravitation was contained in the work of former scientists or contemporaries—in the work of Galileo and Kepler, of Snellius and Fermat, of Christian Huyghens, and of Halley or Hooke. Newton's real merit lay in uniting and concentrating the different and dispersed achievements of these men. The most important and the most characteristic feature of his work was not so much the discovery of new facts as the new *interpretation* of data already available. The general law of gravity had been discussed long before the publication of Newton's *Principia.* All the great physicists and astronomers participated in this discussion. They saw the problem and examined the methods of its solution. Even Newton's formula was not an entirely new discovery. Christopher Wren, Hooke, and Halley, had developed their theories of attraction in which, on the basis of independent considerations, they were led to the conclusion that the centripetal force decreased in proportion to the squares of the distances reciprocally. Newton did not deny or underrate the merits of his predecessors. When he published his *Principia* he added a special scholium in which these merits are frankly acknowledged; he declared that Wren, Hooke, and Halley, had independently deduced the law of gravity from the second law of Kepler.[15]

Since the time of Kepler the hypothesis of general attraction between all the celestial bodies had, indeed, been under considera-

[14] Newton, *Opticks, Book* III, part i; reprinted from the fourth edition (London 1730), New York 1931, p. 404 ff.
[15] See *Principia,* Liber I, Propositio IV, Corollarium 6, Scholium.

tion by all the physicists and astronomers. Kepler had asserted that not only does the earth attract the stone, but the stone also attracts the earth. And this conception plays an important part in his reform of the Aristotelian cosmology. Twelve years before the appearance of Newton's *Principia* Hooke had submitted a paper to the Royal Society in which he investigated the nature and magnitude of this attractive force. He declares that the action of the attractive forces of the celestial bodies increases in proportion to the proximity to their centers of the body on which these forces act. "Now what these several degrees are", continued Hooke, "I have not yet experimentally verified, but it is a notion which, if fully prosecuted, as it ought to be, will mightily assist the astronomers to reduce all the celestial motions to a certain rule, which I doubt will never be done without it. He that understands the nature of the circular pendulum, and of circular motion, will easily understand the whole of this principle, and will know where to find directions in nature for the true stating thereof. This I only hint at present to such as have ability and opportunity of prosecuting this inquiry, and are not wanting of industry for observing and calculating, wishing heartily such may be found, having myself many other things in hand which I would first complete, and therefore cannot so well attend it. But this I durst promise the undertaker that he will find all the great motions of the world to be influenced by this principle, and that the true understanding thereof will be the true perfection of astronomy."[16]

We may infer from these words that Newton's discovery could not come as a surprise to the astronomers and physicists of his own time. This event was carefully prepared for, both in its experimental and in its theoretical aspect. But the really novel, and subsequently decisive, element consisted in Newton's systematic proof of his theory. In this regard he was entirely original. We have indeed very interesting biographical proof that Newton saw his problem in this light. While preparing the first edition of his *Principia* in 1786 he had a letter from Halley in which he was told that Hooke had some pretensions with regard to the first discovery of the law of gravity. Newton, when he heard of Hooke's

[16] Hooke, "An Attempt to Prove the Motion of the Earth", *Philosophical Transactions*, No. 101, p. 12.—See Brewster, *Memoirs* I 286 f.

claims, became so frightened at the prospect of becoming involved in a public controversy on a question of priority that he wished to suppress his third book rather than undergo such an ordeal. "Philosophy", he wrote to Halley, "is such an impertinently litigious Lady, that a man had as good be engaged in lawsuits, as have to do with her. I found it so formerly, and now I am no sooner come near her again, but she gives me warning."[17] The fact that there ever was a moment in Newton's life in which he seriously resolved to suppress one of the most important parts of his classical work, is one of the greatest paradoxes in Newton's biography and in the whole history of science. Many modern writers have been at a complete loss to understand this fact which seemed to be a blot on his personal and scientific character. "One cannot excuse Newton", says one of his most recent biographers, "for his decision to suppress the third book. . . . What manner of a man was Newton who could thus contemptuously cast off his own intellectual child? There is certainly no parallel to the incident in all history. Did any other man ever show a deeper jealousy and vanity than Newton, who could let the personal criticism of another, and a slight reflexion on his own character, outweigh the work of his life and the fruit of his genius?"[18]

I think, however, that we can exculpate Newton from this charge. It is true that during his whole life he feared nothing more than involvement in public disputes about his work. But to ascribe this fact to a sort of moral weakness, let alone to mere vanity or jealousy, seems to me a very poor psychological explanation. Vanity and jealousy would have had the opposite effect; they would rather have incited him to such disputation than deterred him from it. There was more than the mere personal factor in Newton's desire for peace. This desire originated in his respect for his work and for the greatness of his scientific task. If Newton was ever able to bring himself to suppress the third book of the *Principia,* he must have been convinced that this omission could

[17] Newton to Halley, June 20, 1686.—The correspondence between Newton and Halley was first published in the Appendix to Rigaud's *Historical Essay on the First Publication of the "Principia"*, Oxford 1838. It has since been reprinted in Brewster's *Memoirs*, I, Appendix No. viii, 437-456.

[18] Louis Trenchard More, *Isaac Newton, a Biography*, New York and London 1934, 311.

not affect the fundamental value of his work. He thought that the first two books had an independent meaning and merit. And on this point, I suppose, he was quite right. The traditional view is to connect Newton's name with Newton's law. We usually do not differentiate between the two: we see in the law of gravity his principal merit and his real claim for immortality. From the viewpoint of the general history of ideas, however, we ought to revise this judgment. Paradoxical as it may sound, it must be conceded that even without the law of gravity the *Principia* would still stand as one of the greatest achievements of modern science. For in this work Newton bequeathed to posterity not merely a universal law of nature, but also a universal *instrument* of scientific thought and of scientific research. No one before him had the same clear conception of what a "theoretical physics" is and means. Newton's empirical discoveries were the ripe fruits of this original conception. In his ideal of a "scientific induction" the empirical and theoretical elements are welded into an indissoluble unity.

Leibniz's natural philosophy exhibits throughout a different orientation. Whereas Newton started out with the study of certain natural *phenomena*—with an investigation of optical phenomena and with a theory of the motion of the moon, Leibniz, on the other hand, began with a *logical analysis of truth*. "As a man who wishes to construct a building upon sandy ground", he writes in a fragment, "must continue to dig with his spade until he comes to a solid and stony basis, as a man who wishes to untie an intricate knot must find some starting point, and as Archimedes required an immovable point in order to be able to lift the universe;—so we are in need of a fixed point as a foundation upon which we may establish the elements of human knowledge. And this starting point is the analysis of the different kinds of truth."[19] Leibniz fully acknowledges the value of empirical truth. But to his mind empirical truth is only a small part, a fragment, a single sector, of the universe of truth. Behind individual statements of empirical fact, it is the task of the philosopher to discover the necessary forms of thought. In physics we find factual truth; in logic, arithmetic, geometry, we have necessary or eternal truth. But the

[19] See Leibniz, *Opuscules et fragments inédits*, ed. Louis Couturat, Paris 1903, 401.

factual truth of physics does not form an independent realm which, in its fundamental character, is opposed to the truth of logic and mathematics. Both realms have, so to speak, their own rational, constitutional laws. "The great foundation of mathematics", says Leibniz in the second paper addressed to Clarke, "is the principle of contradiction or identity, that is, that a proposition cannot be true and false at the same time; and that therefore it is what it is, and cannot be what it is not. This one principle is sufficient to demonstrate every part of arithmetic and geometry, that is, all mathematical principles. But in order to proceed from mathematics to natural philosophy, another principle is requisite . . . the principle of a sufficient reason, *viz.*, that nothing happens without a reason why it should be *so* rather than *otherwise*. And therefore Archimedes, when proceeding from mathematics to natural philosophy, in his book *De aequilibrio*, was obliged to employ a particular case of the great principle of a sufficient reason."[20] It is this principle that makes physics possible, because it allows us to make the great step from mathematics to nature, to throw a bridge across the gap which, at first sight, seems to separate factual truth (vérités de fait) from necessary truth (vérités éternelles).

This is not, however, a solution of the problem; it is only the statement of the problem. What does Leibniz mean by his "principle of sufficient reason"? We cannot grasp his meaning so long as we take his terms and his arguments at their face value. For his own description of his principle, as contained in his replies to Clarke, is rather vague. "The principle in question", he says, "is the principle of the want of a sufficient reason, in order to any thing's existing, in order to any event's happening, in order to any truth's taking place. Is this a principle that needs to be proved?"[21] Such argumentation seems scarcely worthy of so great a logician as Leibniz. It was open to all the attacks which Hume later directed against the objective validity of the principle of sufficient reason. To discover the true and deeper sense of Leibniz's principle we must consult the whole of his logical work. Leibniz always insists that his principle is pregnant with the most important consequences. From it he expects a real revolution in philosophic

[20] Leibniz to Clarke, Second Paper, sect. i, p. 21.
[21] *Ibid.*, Fifth Paper, sect. 125, p. 275.

and scientific thinking. If understood in its fullest sense this principle will alter the whole realm of metaphysics. It will make metaphysics operative and demonstrative whereas before it generally consisted only of empty words.[22] "It must be confessed", states Leibniz, "that though this great principle has been acknowledged, yet it has not been sufficiently made use of. Which is, in great measure, the reason why the *Prima Philosophia* has not been hitherto so fruitful and demonstrative, as it should have been."[23]

Wherein consists the "greatness", the novelty, the revolutionary power that Leibniz ascribes to the principle of sufficient reason? Leibniz began with a description and classification of the various types of truth. He insisted that logical and mathematical truth is "necessary", whereas empirical truth is "contingent". But he was not content with this discrimination. According to Leibniz this distinction between factual and necessary truth, between the "vérités de fait" and the "vérités éternelles", has only a relative, not an absolute value. It is true that the two kinds do not belong to the same class. They cannot be reduced to a common denominator. But that does not mean that they are opposed to one another or are mutually exclusive. However different they may be, yet they are interrelated. Leibniz liked to illustrate this interrelation by a mathematical example. We may say that "factual" truth is incommensurable with logical and demonstrative truth. There appears to be no common measure. But it is precisely this concept of incommensurability which can lead us to the right solution. If in geometry we speak of incommensurable lengths we mean that these lengths cannot be expressed by our ordinary "rational" numbers. They correspond to "surd" or "irrational" numbers. But these irrational quantities are by no means *indeterminate* quantities. If we cannot express them by an ordinary fractional number, we can find an *infinite series* of rational numbers by which this value is fully determined. The farther we proceed in this infinite series of rational numbers, the more nearly we shall approximate the "true" value of the surd quantity. It is the same with empirical and rational truth.[24] Of course Leibniz admits

[22] *Ibid.*, Fourth Paper, sect. 5, p. 95.
[23] *Ibid.*, Fifth Paper, sect. 21, p. 173.
[24] Leibniz stresses this analogy in many passages. See especially "De libertate", *Nouvelles lettres et Opuscules inédits de Leibniz*, par Foucher de

that there are wide areas of human knowledge in which we have to be content with mere factual truth. All we can do here is to collect the empirical evidence without being able to deduce the facts from higher reasons or principles. But this is only a first and preliminary step. The philosopher and the scientist will never be satisfied with this state of affairs. They will continue their analyses until they come nearer and nearer to their ultimate goal—the goal not merely of collecting, but also of understanding, the phenomena of nature. Rational or necessary truth must be conceived as the ideal, the "limit" of empirical truth. This ideal is not immediately given, but the search for it is the essential task of science and philosophy. Rational truth is the eternal theme of scientific and philosophical investigation. In this sense Leibniz often calls his principle not only the "principle of sufficient reason", but the *"principium reddendae rationis"*.[25] We do not know the reasons behind all things, but we must never despair of finding and proving these reasons. The progress of knowledge is unlimited; nor does knowledge admit of any fixed boundaries. The maxim "plus ultra" was a favorite of Leibniz's.[26] What the "principle of sufficient reason", or still better, the "principium reddendae rationis", really means and emphasizes is that in the last analysis *all empirical truth is describable in terms of rational truth and reducible to the type of rational truth.*[27] Behind every scientific achievement we are sure to find a new scientific problem. But this infinity is in no sense opposed to a genuine rationality. On the contrary, it is the very expression of such a rationality. It means that the individual steps taken in the advancement of our empirical knowledge form a convergent, not a divergent, series. By virtue of this convergence, which is ascertained by the principle of sufficient reason, we can be sure that there is a constant approximation towards truth, that our empirical knowledge of particular facts will, more and more, be reduced to a knowledge of general rules and universal principles.

Careil (Paris 1857) 183; in *Philosophische Schriften* (ed. Gerhardt) VII 200.

[25] *Cf.* "Specimen inventorum de admirandis naturae Generalis arcanis", *Philosophische Schriften* VII 309 Gerhardt.

[26] *Cf.* "Guilelmi Pacidii Plus Ultra, sive initia et specimina scientiae generalis", *ibid.* VII 49-51.

[27] *Cf.* Leibniz, Lettre à Arnauld, July 14, 1686, *ibid.* I 382.

By way of this conception of empirical and rational truth Leibniz was led to his fundamental philosophical concept, the concept of a *"Scientia generalis"*. The principal aim of this "General Science" was to transform all mere *factual* truth into *rational* truth. By a complete analysis of all our thoughts we shall find the means to change mere "facts" into "concepts" and "theories". Such a change is indeed a paradox; it would seem to involve a sort of logical transubstantiation. How can we ever hope to resolve the conditions of concrete, empirical thought into those of abstract, rational thought—to reduce "vérités de fait" to "vérités nécessaires"? Leibniz was convinced that he had succeeded in finding the solution of this riddle. The task will be solved by the power of *symbolic thought*. If we analyse all our ideas into their simple elements, if we express these elements by adequate symbols, if we study the rules of the connection of these symbols, then we shall find a clue of Ariadne which may serve us as a reliable guide in the labyrinth of human thought. Not only mathematical, but also empirical, thought is capable of such a progressive symbolization and formalization. If we understand Leibniz's principle of sufficient reason in this way, we can easily account for the role it plays in the general structure of his philosophy. Leibniz's discovery of the infinitesimal calculus was but one step in this direction. The plan of his "Scientia generalis", founded upon a "Characteristica generalis", had been conceived long before. It became the great unifying force in his thought and in his scientific work. The mind of Leibniz has often been described as "encyclopaedic". But such a description is scarcely adequate. For in addition to a desire to master all sorts of knowledge, he endeavored to understand the various *forms* of this knowledge; and to him this meant deriving and deducing the forms from universal principles. His encyclopaedism was of a systematic, not an eclectic or merely cumulative, type.

The hopes which Leibniz built upon this plan of a "General Science" may seem extravagant to us. His faith in his logical ideal was unshakable. He was convinced that nothing in nature or human life could ever resist the power of rational thought. He applied his method not only to mathematical or physical, but also to political, social, and religious problems. As a youth of twenty-

three in 1659, he wrote his "Specimen demonstrationum politicarum pro eligendo rege Polonorum novo scribendi genere ad claram certitudinem exactum".[28] This political pamphlet was indeed written in a new style. He tried to prove "more geometrico", by mere "arguments in form", that, of all the candidates competing for the Polish throne, Stanislaus Letizinsky was the most entitled and the most promising. By the same method Leibniz tried to convince Louis XIV that it was much better to attack Egypt than to conquer Holland.[29] Even problems of Christian dogmatics were treated in similar fashion. In 1669 Leibniz published a "Defensio trinitatis per nova reperta logica", in which he undertook to defend the Trinitarian dogma against the objections of Wissowatius.[30] In like manner he attempted to refute, by mere logical arguments, the errors of Socinus and the adherents of Socinianism.[31]

If we bear in mind these characteristic features of Leibniz's and Newton's philosophy we can easily understand their discussion of particular questions. They differed not merely in their principles, but also in philosophical temperament, in their general frame of mind. Leibniz was perhaps the most resolute champion of rationalism who ever appeared in the history of philosophy. Not even Hegel could outdo him in this respect. For Leibniz there exists no separation, no chasm, between "reason" and "reality". There is nothing in heaven or on earth, no mystery in religion, no secret in nature, which can defy the power and efforts of reason. "Le réel", he wrote in a letter, "ne laisse pas de se gouverner parfaitement par l'idéal et l'abstrait; c'est parceque tout se gouverne par raison et qu'autrement il n'y auroit point de science ny règle ce qui ne seroit pas conforme avec la nature du souverain principe."[32]

Newton's conception of the task of science was very different. He too felt the pride of a great scientific genius, but this pride

[28] Leibniz, *Opera omnia*, ed. Lodov. Dutens, Genevae 1768, Tom. IV, 3, 522-630.
[29] "Specimen demonstrationis politicae", in *Leibniz' historisch-politische und staatswissenschaftliche Schriften* (ed. Onno Klopp, Hannover 1864 ff.) II 100 ff.
[30] *Opera omnia* (ed. Dutens) I 10 ff.
[31] *Ibid.*, "Remarques . . . sur le livre d'un Antitrinitaire Anglais", I 24 ff.
[32] Leibniz, Letter to Varignon, Feb. 2, 1702, in *Mathematische Schriften* (ed. Gerhardt, Berlin-Halle, 1849 ff.) IV 93 f.

was combined with a great modesty. He never would have accepted the praise contained in Alexander Pope's well known verses:

> Nature and Nature's law lay hid in night,
> God said, "Let Newton be", and all was light.

To Newton nature was accessible to, but not penetrable by, human reason. Whenever he mentioned his own discoveries it was always in a humble way. "I do not know", he once said, "what I may appear to the world; but to myself I seem to have been only like a boy playing on the sea-shore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me."[33] Science may lead us very far, but it cannot hope to probe into the real depth of the "ocean of truth". This depth remains immeasurable and unfathomable to human thought.

We are now in a position better to understand the different role which mathematics plays in the systems of these two men. As regards the objective value of mathematics and its indispensability for natural philosophy, there is not the slightest difference between Leibniz and Newton. They both follow the maxim laid down by Galileo; they are convinced that without mathematics nature would remain a sealed book. Moreover, Newton and Leibniz made the same progress in the general development of mathematical thought. They created a new type of mathematics: the mathematics of variable quantities. It is, however, a very remarkable fact that even here Newton and Leibniz, though pursuing the same end, did not go the same way. As we have indicated, Leibniz's infinitesimal calculus was merely a special application of his general logical method. It is the creation of a new *symbolism* which is the most important point in Leibniz's theory. This symbolism, in its clarity and simplicity, proved to be superior to Newton's method of fluxions, and, after a short struggle, its victory was decided. But it is not the technical side of the problem with which we are concerned here. What is more important is the general methodological aspect of the question. In order to express the difference between Leibniz's differential and integral calculus and Newton's

[33] See Brewster, *Memoirs* II 407.

method of fluxions we may say that Newton, as a physicist, began with a study of *facts*, whereas Leibniz, as a logician, began with a study of *forms*. Of all the facts of nature *motion* is the most general one. According to Newton's mechanics there is no natural phenomenon which is not reducible to motion and its general laws. Hence follows that we shall never find a true correspondence between thought and reality, between mathematics and physics, so long as we exclude the concept of motion from the realm of pure mathematics. It was, however, precisely this exclusion which constituted one of the fundamental and most characteristic features of classical mathematics. Classical mathematics had its origin in Platonic thought. All the great Greek mathematicians, from Eudoxus and Theaetetus down to Euclid, were, directly or indirectly, pupils of Plato. But from a Platonic point of view it would have been a contradiction in terms to admit a concept like motion as a basic principle of geometry. Geometry had been defined by Plato as the realm of the ἀεὶ ὄν. The knowledge at which it aims is knowledge of the eternal, and not of that which is perishing and transient.[34] To introduce into pure mathematics the category of change would be to undermine its truth and certainty. But this was precisely the step taken by Newton. He was not exclusively or primarily interested in the solution of abstract mathematical problems. From the outset of his scientific work he had combined the study of algebra or geometry—the study of infinite series, of the methods of drawing tangents, of the quadrature of curved lines—with a study of natural phenomena, of optical and mechanical questions. Constantly and quite naturally he passed from one field to the other. To such a mind there could be no gap, no Platonic "severance", between the ideal world of mathematics and the empirical world of physics. In order to find the "mathematical principles of natural philosophy" Newton had to alter the traditional conception of mathematics itself. If mathematics was to fulfill its principal task, if it was destined to give us a theory of nature, it could not overlook or minimize nature's principal phenomenon. Motion could no longer be regarded as a mere physical fact; it became a basic concept, a category of mathematics. Such was the problem solved by Newton's theory of

[34] Plato, *Republic* VII 527a.

fluxions.[35] A physical concept, the concept of velocity, was admitted to geometry and algebra. The increase and decrease of abstract quantities was described in terms of mechanics—as an increase or decrease in velocities. In order to determine the ratios of the increments of indeterminate quantities Newton described these increments by the term "moments"; and to the velocities with which the quantities increase he gave the names "motions", "velocities of increase", and "fluxions". He considered quantities not as composed of indivisibles, but as generated by motion.[36] "Quantitates mathematicas", he writes, "non ut ex partibus quam minimis constantes sed ut motu continuo descriptas hic considero."[37] This was not in itself an entirely new conception. We find the same view of a "generation" of curved lines or solids by continuous motions in Descartes' geometry or in Kepler's "Stereometria doliorum". But in these cases the term "motion" is used in a mere metaphorical sense. It had not yet been naturalized in the realm of mathematics. To legitimatize this concept of motion was one of the principal aims of Newton's theory of fluxions. For this purpose he had to change the whole hierarchy of the sciences. In his system mechanics is no longer subordinated to geometry; it becomes the very basis of geometry. "It is the glory of geometry", says Newton in the Preface to the *Principia*, "that from few principles brought from without, it is able to produce so many things. Therefore geometry is founded in mechanical practice, and is nothing but that part of universal mechanics which accurately proposes and demonstrates the art of measuring."[38] In Leibniz we find the classical hierarchic order of scientific knowledge. Geometry and arithmetic are subordinated to logic: all their truths can be derived from the mere principle of contradiction. In mechanics and physics it is necessary to introduce a new principle,

[35] For the history of the theory of fluxions and for all technical details I must refer the reader to the monographs on the subject. See, for instance, Ferdinand Rosenberger, *Isaac Newton und seine physikalischen Prinzipien*, Leipzig 1895; and Léon Bloch, *La philosophie de Newton*, Paris 1908.

[36] For further details see Brewster, *Memoirs* II 11 ff.

[37] "De quadratura curvarum", Introductio, in *Isaac Newtoni Opuscula mathematica philosophica et philologia* (ed. Johann Castillioneus, Lausanne and Geneva 1744) I 203.

[38] *Principia*, Preface to first edition, English translation by Andrew Motte in 1729; reprinted in the edition of the University of California Press, Berkeley, California, 1934.

the principle of sufficient reason. But even mechanics is simply an "applied" arithmetics and geometry—a study of geometrical and arithmetical relations *in concreto*. By virtue of Newton's new orientation of mathematical thought, by the introduction of the concept of velocity into "pure" mathematics, all this was completely changed. If we consider abstract quantities as generated by continuous motions, this is not a mere figure of speech. It expresses a real fact, "Hae geneses", declared Newton in his work on the quadrature of curved lines, "in rerum natura locum vere habent et in motu corporum quotidie cernuntur."[39] In other words, such generations of quantities as are supposed in the new calculus are not figments of the human mind, nor are they mere mathematical conventions. They have a *"fundamentum in re"*—a support and basis in the nature of things. We do not merely conceive or imagine, we see and experience, these generations.

Leibniz's approach to the infinitesimal calculus was quite different. He saw the problem from the viewpoint of logic, not from that of the physicist. As a mathematician Leibniz always remained faithful to the great classical tradition. He spoke as a resolute Platonist. To him mathematics was a branch of logic. But it was logic itself which in the philosophy of Leibniz had assumed a new shape. He by no means despised the methods of traditional logic, of Aristotle and the Schoolmen. He defended their right against the attacks of the moderns. In his *Nouveaux Essais sur l'entendement humain* he praises the invention of the various forms of the syllogism as one of the most beautiful, and as one of the most important, achievements of the human mind. "It is a species of *universal* Mathematics", he asserted, "whose importance is not sufficiently known; and it may be said that an *infallible art* is therein contained, provided we know and can use it, which is not always allowed."[40] The same view is given in a letter of Leibniz to Gabriel Wagner (1696), which was written for the express purpose of defending the Aristotelian logic against its modern critics and detractors.[41] On the other hand the syllogistic science

[39] Newton, "De Quadratura curvarum", Introductio, *Opuscula*, ed. Castillioni, I 204 f.

[40] *Nouveaux Essais*, Livre IV, chap. 17, sect. 4.—Eng. translation by A. G. Langley, second ed., Chicago and London, 1916, p. 559.

[41] See *Philosophische Schriften*, ed. Gerhardt, VII 514 ff.

of Aristotle did not represent for Leibniz the whole extent of logic, but only a small portion. In his "Characteristica generalis" he had found and studied types of arguing and reasoning entirely different from those contained in the classical logic. "You appear to apologize for common logic", replies Philalethes in the *Nouveaux Essais,* "but I see clearly that what you bring forward belongs to a more sublime logic, to which the common is only what the alphabet is to scholarship."[42] Leibniz had in view not the destruction, but the perfection, of classical logic. He wished to analyse all the possible types of deductive reasoning and give them adequate symbolic expression.[43] The new calculus was but a single chapter in this larger work. It was not based on the observation of natural phenomena; it was derived from a mathematical concept which first became explicit in the thought of Leibniz—*in the general concept of function.* Leibniz's analysis brought this concept into focus so that it became one of the most powerful instruments of modern mathematics. In this regard we cannot look upon Leibniz and Newton as rivals or adversaries. They set themselves different tasks, and they performed these tasks by different means. Newton attained his end by a new orientation of physical thought; Leibniz attained his by a new orientation of logical thought.

Looking at the conflict in this light we can give both men their due. We can free their controversy from all those accidental and merely personal circumstances which have obscured it from the start. Even one of the most intricate problems appears now in a new perspective. For a modern reader there is perhaps no more interesting problem in this controversy than that of *space and time.* On this issue the crisis of seventeenth-century philosophic and scientific thought suddenly developed. For Newton space and time were not only real things, but the very framework of reality. They belong not merely to the material world; they are absolute attributes of God. All this is asserted by Leibniz to be radically wrong. Time and space are not separate existences; they possess no substantial reality of their own. They are "forms" or "orders", not things; they are not absolute, but merely relative. Here Leibniz

[42] *Nouveaux Essais,* Livre IV, chap. 17, sect. 7.—Eng. tr., p. 566.
[43] For all details I refer to the excellent account in Louis Couturat, *La Logique de Leibniz,* Paris 1903.

envisaged a problem which only in recent times has received clear and explicit statement. For him space and time have no independent physical or metaphysical existence. Space is the order which renders bodies capable of being situated, and by which they have a situation among themselves, when they exist together; time is that order with respect to their successive positions.[44] "In order to have an idea of place, and consequently of space, it is sufficient to consider relations and the rules of their changes without needing to fancy any absolute reality *out of* the things whose situation we consider."[45]

I cannot enter into a systematic discussion of the problem itself. I wish only to elucidate the historical side of the question. In Leibniz's and Newton's theories of space and time we find the same fundamental opposition which we were able to observe in all other fields. This opposition does not originate in a mere dispute between individual thinkers or in a conflict between philosophical schools. Newton and Leibniz apply different *standards* of truth and they employ different frames of reference. Newton argues upon a principle that at first sight seems to admit of no doubt. If there is any truth, it must be found *"in rerum natura"*. All truth must be based on facts. Even mathematical truth—the so-called "ideal truth"—forms no exception to this general rule. Newton had found a new type of mathematics—the mathematics of variable quantities. He was convinced that this form of mathematics, the doctrine of "fluxions", would not be possible without a substantial foundation, a *substratum* in reality. We cannot study the relations between variable quantities without presupposing that uniform and continuous motion which we call "duration" or "flux of time". If we take away this substratum all physical things and all mathematical truth lose their foundation. Absolute, true, and mathematical time is no mere concept; it is a fundamental reality which of itself and from its own nature flows equably without relation to anything external.[46] Leibniz, too, is convinced that there must be conformity, if not identity, between "truth" and "reality". There is no chasm between the "ideal" and the "real"

[44] Leibniz, Third Paper to Clarke, sect. 4, p. 57; Fourth Paper, sect. 41, p. 113.
[45] Leibniz, Fifth Paper, sect. 47, p. 199.
[46] See Newton, *Principles*, Book I, Definition 8, Scholium.

world; they are united by a "preestablished harmony". But Leibniz stresses the opposite pole. The nature of things and the nature of mind agree. Yet very often—Leibniz objects in criticizing Locke—"the consideration of the nature of things is nothing else than the knowledge of the nature of our mind, and of those innate ideas which we have no need to seek outside."[47] To Newton's realistic theory of space and time Leibniz opposes his own idealistic theory. But the *term* "idealism" is not sufficient to give us a clear characterization of the difference. As a result of the wide variety of senses in which this term has been used in the history of idealism, it has become vague and misleading. There are almost as many forms of "idealism" as there are philosophical schools or systems. Leibniz's idealism is an "objective", not a "subjective" idealism; a mathematical, not a psychological idealism; a Platonic, not a Berkeleyan idealism. Thus when Leibniz asserted the "ideality" of space and time he never meant to cast any doubt upon the objective *truth* of these concepts. He always compares this ideality with the ideality of numbers. Number being the very foundation of mathematics, it is logically immune to attack. But Leibniz objects to the *interpretation* of the objective truth of space and time contained in Newton's system. For Leibniz space and time are *relations* or *orders*, not *absolute* existences or entities. Space is the "order of coexistences"; time the "order of successions". "These things consist only in the truth of *relations*, and not at all in any absolute reality."[48] This truth of relations is dealt with in Leibniz's logic. For him the theory of space and time belongs to logic, not to physics. These concepts are parts of a greater universe, of the universe of logical forms or, as Leibniz calls it, of the *"intellectus ipse"*.

We may conclude, then, that the theories of space and time of Newton and Leibniz, while diametrically opposed *ontologically*, have, nevertheless, a point of contact. This becomes clear when we approach the problem from the *epistemological* angle. Epistemologically the two theories have a common feature because they have a common adversary. They both resist the thesis upheld by all the schools of English empiricism and sensationalism. Space

[47] *Nouveaux Essais*, I, 1, 21 (English translation by A. G. Langley, p. 74).
[48] Leibniz, Fifth Paper, sect. 47, p. 205.

and time cannot be described and defined in terms of mere sense-perception. With this negative statement Newton and Leibniz are in complete agreement. But even here their judgments are based upon different reasons. For Newton it is clear that space and time, as absolute entities, are beyond the reach of immediate sense-experience. For Leibniz, on the other hand, they are pure intellectual forms which involve a constructive power of the human mind. The equal and uniform flux of time signified for Newton an ultimate substantial *reality;* for Leibniz, however, it amounted to a necessary assumption, a fundamental *hypothesis.* If, with our conventional historical classifications in mind, we study the famous scholium of Newton's *Principia,* in which he insists on the distinction between absolute and relative motion; we are at first confronted with a curious paradox. Newton begins by sharply distinguishing between the concepts of "the vulgar" and the true scientific concepts. Common people conceive space, time, and motion, according to no other notions than the relations these concepts bear to sensible objects. But from such a habit of thinking certain errors and prejudices arise which have to be eradicated by philosophic thought. Because the parts of absolute space cannot be seen or distinguished from one another by our senses, we tend to substitute sense measures for absolute measures. This is without inconvenience for the purposes of everyday life, but it will not do for *philosophy.* Here we wish to know the true nature of things, and to this end we must abstract from our senses and consider the things themselves as distinguished from our measures of things according to the standards of the senses alone: "in philosophicis abstrahendum est a sensibus."[49] Who is speaking here, we are tempted to ask. Is it Newton, the great empiricist, or his adversary, the "intellectualist" and rationalist Leibniz? As a matter of fact both Newton and Leibniz reject the standards of sensationalism. The senses, taken in themselves, cannot yield us the truth. But here again the two thinkers pursue this principle in a twofold direction. Newton is intent upon determining the substantial reality of space and time as two infinite, homogeneous things, independent of any sensible object. Leibniz no longer

[49] See *Principia,* Book I, Definition 8, Scholium.—English translation by Motte, New Edition, Berkeley, Calif., 1934, p. 8 ff.

admits such a reality. According to him, if we wish to find the ultimate source of our ideas of "pure space" and "pure time", we shall have to inquire into the nature of our *intellect* rather than into the nature of *things*. This difference is very clearly expressed in a passage of the *Nouveaux Essais sur l'entendement humain*. "A succession of perceptions awakes in us the idea of duration, but it does not make it. Our perceptions never have a succession sufficiently constant and regular to correspond to that of time, which is a continuum uniform and simple, like a straight line. Changing perceptions furnish us the occasion for thinking of time, and we measure it by uniform changes. . . . So that knowing the rules of different motions, we can always refer them to the uniform intelligible motions. . . . In this sense time is the measure of motion, *i.e.*, uniform motion is the measure of non-uniform motion."[50] We have here the key to Leibniz's opposition to all sensationalist theories as well as to his opposition to Newton's realistic theory.

It is usual, and it appears to be natural, to look upon the controversy between Newton and Leibniz as a collision between scientific and metaphysical thought. But if we accept this interpretation we are faced with a grave difficulty. How can we account for the fact that our *modern* theories of space and time have adopted the "relativistic" theory of Leibniz, whereas they have very severely criticized the Newtonian concepts of absolute space and time? Shall we say that since the time of Newton science has developed from an empirical state to a more "metaphysical" state? This would of course be a very strange and dubious way of stating the problem. To regard Newton as a mere "empiricist" would be just as wrong as to regard Leibniz as a mere "metaphysician". In the seventeenth century we cannot draw such a line of demarcation between metaphysical and mathematical, between theological and physical thinking.[51] What both Newton and Leibniz call "natural philosophy" is still embedded in the greater whole of metaphysics. Leibniz could not develop

[50] *Nouveaux Essais*, Livre II, chap. 14, sect. 16: English translation by Langley, p. 156.

[51] In the case of Malebranche this has been shown in a very interesting and suggestive article by Paul Schrecker, "Le Parallélisme théologico-mathématique chez Malebranche", *Revue Philosophique* LXIII (1938) 87-124.

his theory of space and time without constantly referring to his fundamental metaphysical conceptions, to his monadology, his principle of the "identity of indiscernibles", and his system of "preestablished harmony". Newton, on the other hand, however reserved in his judgment about the "ultimate causes" of natural phenomena, never could avoid metaphysical problems. He had very definite conceptions of the nature of the deity, and of the general structure of the spiritual world and its connection with the material universe.[52] In the "queries" added to his *Opticks* Newton treated all these questions explicitly. To speak of Newton as if he were a precursor of Comte and his positivistic philosophy is, indeed, impossible. The whole intellectual atmosphere of Newton's thought and scientific work is in flagrant contradiction to the spirit of positivism.[53] When Newton's *Principia* first appeared it was hailed not only as the work of a great scientist, but also as the work of a great theologian and of a great religious thinker. The most influential theological schools in England were unanimous in this judgment. In Newton's book they saw the firmest stronghold against those systems of natural philosophy which threatened to subvert the foundations of natural religion and the Christian faith.[54] The modern reader's interest in all this is little more than historical. What he seeks and finds in the documents of the dispute between Leibniz and Newton is something quite different. It is a logical and epistemological, not a metaphysical, problem. As has been shown, it is the *logical* structure of space and time which was seen in a new light in the philosophy of Leibniz. Instead of propounding a theory of the absolute *"essence"* of space and time, Leibniz began with a critical study of the *"meaning"* of these terms. It was this critical tendency of thought which proved to be pregnant with far-reaching consequences for both science and philosophy. When Einstein, two centuries later,

[52] For fuller documentation I refer to the detailed account of the metaphysical background of Newton's theory of space and time in my book, *Das Erkenntnisproblem*, third edition, Berlin 1922, II 442-472.

[53] The best and most convincing refutation of a "positivistic" interpretation of Newton's work has been given by Prof. E. A. Burtt, *The Metaphysical Foundations of Modern Physical Science*, 1924, Revised Edition, New York 1932. See especially pp. 223 ff.

[54] For this problem I refer to the very interesting material contained in the book of Helène Metzger, *Attraction universelle et religion naturelle chez quelques commentateurs anglais de Newton*, Paris 1938.

developed his special theory of relativity he found it necessary, first and foremost, to analyse the "meaning" of time. This seems to me to be the real point of contact between the views of Leibniz and those of modern science.

In the eighteenth century the great scientists still had implicit faith in Newton's authority. In 1748 Euler wrote his *Réflexions sur l'espace et le temps*,[55] in which he tried to prove that without the Newtonian concepts of an absolute space the law of inertia and, accordingly, the whole system of mechanics would become meaningless. The *results* of Newton's physics were so closely interwoven with his fundamental *concepts* that it seemed impossible to give up or change the latter without endangering the former. Any such attempt—it was felt—was bound to end in complete scepticism and anarchy. To many great physicists Leibniz's theories concerning the relativity of space and time appeared to be subversive thoughts. An entirely new and fresh intellectual impulse was required to perceive that these subversive thoughts could be turned into *constructive* thoughts, that a new system of physics could be built upon the ruins of the Newtonian concepts of space and time. "Several men had written systems of philosophy before Sir Isaac", declared William Emerson in his commentary on Newton's *Principia* (1770), "but, for their ignorance of nature, none of them could stand the test. But his principles being built upon the unerring foundation of observations and experiments, must necessarily stand good till the dissolution of nature itself."[56] Even as late as the mid-nineteenth century commentators and biographers of Newton were still talking in a similar vein. "To have been the chosen sage summoned to the study of that earth, these systems and that universe,—the favoured lawgiver to worlds unnumbered, the high-priest in the temple of boundless space", exclaimed David Brewster in his *Memoirs of the Life, Writings, and Discoveries of Sir Isaac Newton*, "was a privilege that could be granted but to one member of the human family;—and to have executed the task was an

[55] *Histoire de l'Académie Royale des Sciences et Belles Lettres à Berlin*, Année 1748.

[56] William Emerson, "A Short Comment on Sir Isaac Newton's *Principia*", in *The Mathematical Principles of Sir I. Newton* (New Edition, London 1803) III 86.

achievement which in its magnitude can be measured only by the infinite in space, and in the duration of its triumphs by the infinite in time. That Sage—that Lawgiver—that High-priest was Newton."[57] No modern scientist would subscribe to this judgment without critical reservations. Yet this apparent detraction takes nothing away from the fundamental merits of Newton. For it is not the method of Newton but the dogmatic faith in his results, and the uncritical use made of his principles, which had to be overcome by the further development of scientific thought. As Einstein said in an article published at the second centenary of Newton's death,[58] theoretical physics outgrew Newton's framework, which for nearly two centuries had provided fixity and intellectual guidance for science.

From the dispute between Leibniz and Newton and its prolongation through the two following centuries we may draw a general conclusion. Conflicts within the realm of scientific and philosophic thought appear to be unavoidable. But amid these incessant combats it is comforting to see that the opposing powers, instead of being mutually destructive, are of mutual assistance to, and steadily cooperate with, one another. If, as in the case of Newton and Leibniz, the battle is fought between two thinkers of equal intellectual stature, then the struggle does not end in the defeat or victory of one party; it leads rather to a new synthesis of scientific and philosophic thought.

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[57] Brewster, *Memoirs* I 319.
[58] *Manchester Guardian*, March 19, 1927.

DISCUSSION

THE CONCEPT OF CONTINUITY IN DEWEY'S THEORY OF ESTHETICS

THE central thesis in Dewey's esthetic theory is what he terms the "continuity" of esthetic with ordinary experience. He considers it the "primary task" of the esthetician "to restore continuity between the refined and intensified forms of experience that are works of art and the everyday events, doings, and sufferings that are universally recognized to constitute experience".[1] This means partly that art should be studied in relation to other forms of human activity and other modes of natural existence. It also means that the esthetician must assimilate art to the practical and the intellectual by interpreting the esthetic as an "idealization" or "intensification" of traits or qualities found in common experience (11, 46). What I propose to discuss is the efficacy of Dewey's method of differentiating the esthetic from, and at the same time assimilating it to, the practical and the intellectual. Working from a general definition of the traits of the esthetic, Dewey would provide a kind of distinction between the esthetic and the practical and the intellectual, while showing them capable of an identical essence. He would demonstrate invalid the distinction of them as different *kinds* of experience, reinterpreting them as complementary phases of any "complete" activity, differing in the emphasis with which they qualify particular experiences.

Dewey assimilates intellectual and practical to esthetic experience on the basis of a common form present in all "complete" experience. He says: "The most elaborate philosophic or scientific inquiry and the most ambitious industrial or political enterprise has, when its different ingredients constitute an integral experience, esthetic quality" (55). And the esthetic is distinguished from the practical and intellectual in two ways: one concerns the results of the experiences rather than the experiences themselves; the other is a quantitative distinction of "degree", "dominance", or "intensity", within the experiences.

The first distinction is explained thus: "In an intellectual experience, the conclusion has value on its own account. It can be extracted as a formula or a "truth", and can be used in its independent entirety as a factor and guide in other inquiries. In a work of art there is no such self-sufficient deposit. The end, the terminus, is significant not by itself but as the integration of the parts. It has no other existence" (55). Presumably the same analysis applies to practical experience, the point being that when we build a machine it may be

[1] *Art As Experience* 3. Unless otherwise indicated all following quotations are from this book.

used to make other machines or articles, but when we make a work of art it can be used to no further artistic end. While this is somewhat suspect (as in the case of mixed arts like the opera or the dance) it suffices here to note that the distinction does not explain how esthetic differs from intellectual and practical experiences *as* experiences. Instead it differentiates their objective products in the status of things independent of the experiences in which they originate.

The manner in which the esthetic, or the "distinctively" esthetic, is distinguished from other forms of experience, is expressed in Dewey's description of the esthetic as an "intensification" or "idealization" of common experience (46). The distinction is that the "dominantly" esthetic has more of what it has, is *more* esthetic, *more* complete, than the practical and the intellectual. "In a distinctively esthetic experience, characteristics that are subdued in other experiences are dominant; those that are subordinate are controlling—namely, the characteristics in virtue of which the experience is an integrated complete experience on its own account." (55). "An object is peculiarly and dominantly esthetic, yielding the enjoyment characteristic of esthetic perception, when the factors that determine anything which can be called *an* experience [a "complete" experience, that is] are lifted high above the threshold of perception and are made manifest for their own sake" (57). The difficulty is that Dewey does not explain these "characteristics" and "factors" defining the esthetic in a way that enables us to differentiate degrees of esthetic quality.

The basic concept in Dewey's account of the esthetic is that of human nature; the esthetic is a development of traits involved in the most rudimentary functioning of the human organism. A few selections will indicate the position. "The first great consideration is that life goes on in an environment; not merely *in* it but because of it, through interaction with it" (13). The second point is: "Life itself consists of phases in which the organism falls out of step with the march of surrounding things and then recovers unison with it—either through effort or by some happy chance" (14-15). This fact of interaction sets for experience a common pattern consisting of a more or less integrated alternation of two phases, denominated "doing" and "undergoing". Dewey illustrates: "A man does something; he lifts, let us say, a stone. In consequence he undergoes, suffers, something: the weight, strain, texture of the surface of the thing lifted. The properties thus undergone determine further doing. The stone is too heavy or too angular, not solid enough; or else the properties undergone show it is fit for the use for which it is intended. The process continues until a mutual adaptation of the self and the object emerges and that particular experience comes to a close" (44). And

"what is true of this simple instance is true, as to *form*, of every experience" (44; italics mine). As applied to esthetic experience: "art, in its form, unites the very same relation of doing and undergoing. . . . Because of elimination of all that does not contribute to mutual organization of the factors of both action and reception into one another, and because of selection of just the aspects and traits that contribute to their interpenetration of each other, the product is a work of esthetic art. . . . The doing or making is artistic when the perceived result is of such a nature that *its* qualities *as perceived* have controlled the question of production" (48). That is, the experience is esthetic when the qualities undergone direct further inquiry into, or manipulation of, the object, and when the active inquiry further discovers and integrates qualities.

As this view is developed Dewey tends to describe the esthetic object and form in terms of the experience of it, and then to describe the experience in terms of formal structure; the defining adjectives, however, are in each case the same—"whole", "complete", "integrated"—and apparently they are the keys to the esthetic nature. Dewey indicates that what is essential to the esthetic is that there are satisfied "all the other [than one of the single, specialized] structures and needs that have a part in the experience, so as to bring it to a completion as a complex of all elements" (115). But he cannot mean that any need with which the human being is ever visited, or any structure he embodies, must find satisfaction or operation in all esthetic experience. Without specifying needs and structures or relating them to objective elements, Dewey shifts perspective to the object, saying: "This interfusion of all properties of the medium is necessary if the object in question is to serve the whole creature in his unified vitality" (117). If we are not left in the circle of a definition of esthetic experience in terms of objective form, and a definition of objective form in terms of esthetic experience, it must be by the signification of the terms by which Dewey describes both—"whole", "complete", "coherence", "harmony", "integration", "fulfilling", "consummatory". The "rhythm" of doing and undergoing will be properly balanced and the "rhythms" of external nature (*i.e.*, causal uniformities) esthetically employed, only when these terms apply (Ch. vii). What specifically do they mean?

The part of Dewey's treatment of esthetic phenomena that has been judiciously considered his main contribution is his discussion, in the chapters on "The Common Substance of the Arts" and "The Varied Substance of the Arts", of the manner in which the artist develops an idea in a particular medium.[2] Dewey shows, for example, how

[2] This is the view of E. A. Shearer in "Dewey's Esthetic Theory", appearing in successive issues of the *Journal of Philosophy*, 1935, Part I, p. 617 ff.; Part II, p. 650 ff. See particularly Part II.

the visual qualities of a painting embody as their "meaning" qualities of senses other than sight, the special medium in which the painter works. However, the fact that, or the way in which, qualities of one sense call forth other qualities or ideas, does not indicate the nature of the organization of any elements that are involved. Clearly not all of the "meanings" possessed by the qualities of an art work are esthetically relevant; therefore the question is as to the nature of the structure—designated by "whole", "complete", etc.—that determines which meanings are intrinsic and which extrinsic to the esthetic object.

Patently the terms "whole", "complete", etc., signify that the phases or elements of the experience and object are related. But does the relation allow of distinctions of degree, so that there can be practical and intellectual experiences which are essentially but not dominantly esthetic? *Prima facie* it would seem that degrees concern primarily not relations but qualities. The only obvious kinds of relation that can be meaningfully differentiated into degrees are those whose very nature is that of quantitative degree, as extension, weight, time. In relations such as cause and effect and implication, quantity or degree seems irrelevant.[3] *M* is causally related to *N* or *M* is not; *X* does imply *Y* or *X* does not; John is Sam's cousin or he is not. What kind of relation do "whole", "complete", etc., represent? The possibility that Dewey means to designate a sensuous or emotional quality by these terms is excluded, if by nothing else, by his doctrine that the qualitative is always unique and that only relations can be known: since only a relation could be common to esthetic experiences only it could assimilate or differentiate them.

Of the esthetic relation Dewey says: "Mutual adaptation of parts to one another in constituting a whole is the relation which, formally speaking, characterizes a work of art . . . each part is a dynamic part, that is *plays an active part*" (134-35). The relation then is internal; the object is so composed that it is what it is only with the participation, in their exact nature and organization, of each of the parts, and the parts are what they are only by their mutual and complete participation in this exact way. Esthetic creation and experience must then select each element of their object with reference to the others, merging them into a whole internally various but qualitatively single.

Now such a description would seem to contrast effectively the esthetic with what is ordinarily meant by the practical and the intellectual, but to distinguish them in kind and not in degree. Practically

[3] The quantification of causal relations demonstrates, of course, that within the causal relation there are certain uniformities governing the variations of cause and effect, not that the causal relation may be present in varying degrees.

it would appear, for example, that one could straighten the papers on his desk without creating the sort of organization described above; or that intellectually one could study the nature of the esthetic experience without the qualitative composition essential to the entertainment of esthetic experience. Dewey agrees that such experiences *may* be without esthetic quality (to the extent that they are not "complete"), but he maintains that, while being dominantly practical or intellectual, they may also possess esthetic quality in a less intense degree than the "distinctively" esthetic experience. I do not see how this "mutual adaptation of parts" can be present in varying degrees. Like the relations of cause and effect and logical implication I should suppose that this esthetic relation is either present or absent among a given set of elements, not that it exists more or less.

The difficulty increases when we inquire into the assimilation of esthetic to practical and intellectual experience. Dewey's definition of the esthetic as the rhythmical combination of doing and undergoing so as to effect a fusion of means and ends, parts and whole, meanings and qualities, mediate discrimination and immediate enjoyment—this does distinguish the esthetic from experiences that do not effect this fusion, and assimilates the esthetic to the practical and the intellectual on the basis of their common possession of the union. Now it is not difficult to discover types of experience that are excluded by this definition, instances of experience, that is, in which there are *only* means or *only* ends, only inquiry and manipulation or only enjoyment.[4] Effort is often fruitless, instituting means that do not eventuate in the intended result; immediate enjoying or suffering is often so absorbing or violent that feeling contains no body of meaning, no discrimination of elements. Such experiences are not "complete", and cannot have esthetic quality. But the nature of this union of elements is not more specifically defined to indicate how, within the remaining area of the "complete", successful practical and intellectual experiences are distinguished from those that are "distinctively" esthetic. The failure of distinction is a failure of definition, and, since these kinds or degrees of experience are assimilated and distinguished by the same traits, the failure is reflected in the ineffectiveness of Dewey's effort at their assimilation.

That the intellectual experience may have esthetic quality Dewey argues on the ground that immediate qualities and mediate meanings are not exclusive; qualities in a composition take their effect from the qualities with which they are combined, relations thereby determining their nature; and meanings or ideal relations possess qualitative content. "Different ideas have their different 'feels', their

[4] For representative statements see *Human Nature and Conduct*, Modern Library Edition, 143-44; *Experience and Nature*, 360-62.

immediate qualitative aspects, just as much as anything else. . . . For this reason certain trains of ideas leading to their appropriate consummation (or conclusion) are beautiful or elegant. They have esthetic character" (120). But Dewey does not mean by the immediacy of ideas the emotional hold some of them may obtain over us, for this hinders rational thinking, whereas he believes that effective thought becomes possible only by use of the immediate qualifications of ideas. "One who is thinking his way through a complicated problem finds direction on his way by means of this (qualitative) property of ideas. Their qualities stop him when he enters the wrong path and send him ahead when he hits the right one. They are signs of an intellectual 'Stop and Go'. If a thinker had to work out the meaning of each idea discursively, he would be lost in a labyrinth that had no end and no center. Whenever an idea loses its immediate felt quality, it ceases to be an idea and becomes, like an algebraic symbol, a mere stimulus to execute an operation without the need of thinking" (120). Dewey apparently means then that the logical relations of ideas are expressed in qualities immediately discoverable to the thinker. One cannot refrain from remarking that, at the least, this is a queer notion for one of Dewey's convictions regarding knowledge and truth. The failure of these views to collide, I suggest, is due to the meaninglessness in Dewey's account of this qualitative aspect of ideas.

The qualitative character of ideas is offered as the explanation of the facility with which a connected train of thought develops. But quality means, not an explanatory principle or mediatory factor, but something felt. In a certain sense we may "feel" that a set of ideas are connected in a certain way, and logical analysis may prove us correct. Yet in other cases we may either feel ideas to be connected in a way which logical analysis shows to be false, or feel ideas not to be connected at all, or be unaware of any particular connection, where actually a connection exists. To the retort that such a deficiency indicates merely the lack of a proper sensitivity to intellectual qualities, the rejoinder is that such sensitivity is exactly parallel with perception of logical connection and familiarity with the ideas in question; and that we should therefore conclude that the connection is ***known,*** not "felt", and that it is reflective habits rather than qualitative sensitivity that direct the thinker on his way in solving a complicated problem. Since the existence of this perception of intellectual "quality" varies in direct ratio, and takes identical manifestations, with cognitive perception, the former is a mere name describing nothing new in the thinking process, and, in terms of its intent, is strictly meaningless. In any case the qualities which Dewey is trying to describe are something quite different from the sensuous or emotional qualities of the distinctively esthetic, so that he does not approximate

the intellectual to the esthetic by finding something that he calls by the same name as esthetic qualities.

Of the potentiality of the practical to acquire esthetic quality, the basic argument (of a number of passages[5]) seems to be that every case of esthetic experience involves practice or "doing". Dewey makes much of the point that esthetic and useful objects are frequently identical, and that in many cases artistic arose out of practical activity; rugs, baskets, buildings, are often both useful and esthetic. But he holds that esthetic experience *necessarily* involves practice, and neither historical origin nor frequent conjunction proves this; causes need not be of the same nature as their effects, and, as the organic may be distinct from the inorganic though arising out of it, so may art have arisen out of practice and yet be distinct from it. The crucial point then is the involvement of "doing" in esthetic experience.

In his general statement Dewey seems to mean by the phase of doing in esthetic appreciation only the active operation of inquiry in exploring the object and elaborating its esthetic quality. This phase of practice in esthetic contemplation is described at one point as: "an ordering of the elements of the whole that is in form, although not in details, the same as the process of organization the creator of the work consciously experienced. . . . The artist selected, simplified, clarified, abridged and condensed according to his interest. The beholder must go through these operations according to his point of view and interest" (54). If the contention is only that an active examination of the object's relations must be made by the spectator as well as the creator of art, I believe there can be no valid objection. But Dewey seems to say that the beholder must incipiently or vicariously repeat the process of artistic production, paralleling a discrimination of the parts of the esthetic object with a reference to their process of production. He says that the esthetic experience is "inherently connected with the experience of making", and, illustrating with the case of a finely wrought object which, after having been taken to be the product of some primitive people, is discovered to be an accidental natural product, finds the result to be that at once "A difference is made in appreciative perception" (48-9). "As production

[5] Examples are: "Any practical activity will, provided that it is integrated and moves by its own urge to fulfillment, have esthetic quality" (*Art as Experience* 39). "Because experience is the fulfillment of an organism in its struggles and achievements in a world of things, it is art in germ" (*ibid.* 19). "For all the intelligent activities of men, no matter whether expressed in science, fine arts, or social relationships, have for their task the conversion of causal bonds, relations of succession, into a connection of means-consequence, into meanings. When the task is achieved the result is art" (*Experience and Nature* 369-70). And art is "an esthetic perception together with an *operative* perception of the efficiencies of the esthetic object" (*ibid.* 375).

must absorb into itself qualities of the product as perceived and be regulated by them, so, on the other side, seeing, hearing, tasting, become esthetic when relation to a distinct manner of activity qualifies what is perceived" (49). Since seeing and hearing *become* esthetic only as they are viewed in relation to their means of production, the perception of this relation must be essential to esthetic experience.

Is this true? To enjoy a work of art one must perceive the composing elements and relations, and in so far re-create what the artist created. But is it necessary that the appreciator understand also how the painter achieves a color, or how the violinist executes an arpeggio? I suppose one may esthetically appreciate also the process of production; the synchrony, for example, of bowing, fingering, and posture, of an artist like Heifetz may be appreciated as a visual thing, like a dance. But: (a) there are other artists (such as Ruth Posselt) who present an appreciable musical rendition but whose palestric entanglements with their instruments leave only the primary musical object for esthetic contemplation; (b) there are other arts where the nature of the productive process can only be inferred (as in painting, sculpture, etc.); and (c) there are yet other arts in which the productive process is a thing so elusive that not even the creator can well describe its career. Moreover, where the productive process is appreciated esthetically, it constitutes an object distinct from the art work contemplated in its obvious, finished form. It is an object also which, as artistic technique, requires for its appreciation technical ability in the art. Thus Dewey's argument for the universality of esthetic experience so far turns upon itself that its specific development implies that only artists can appreciate art.

This is the dilemma: If Dewey construes the "doing" involved in esthetic appreciation only in the sense of active inquiry, then the term is used in a metaphorical sense; it does not assimilate successful practical experience to esthetic appreciation, and it distinguishes the two, not in degree, but in kind. If "doing" is construed as an incipient or vicarious artistic performance, then it constitutes not an element in all esthetic experience, but an appreciation distinct from the contemplation of the finished product. In neither case is it shown that practice is an essential ingredient in esthetic experience.

In conclusion I suggest that Dewey propounds, in his treatment of the esthetic, a conception of what he considers as generally satisfactory experience,[6] and that in this accomplishment he glosses over

[6] From the theory that both means and end, process and product, must be part of an experience that is complete, Dewey draws a general ethical critique of the prevailing economic system. He adduces instances of the way in which the capitalistic system segregates not only social classes but the individual's experiences, thus rendering experiences generally incomplete and unsatisfactory. For example, complete experiences are excluded from the life of the factory laborer whose work is mechanical (not fused with

genuine distinctions among kinds of experience within this general area of the satisfactory. This is of course not a criticism, but an interpretation of the criticisms made. I have tried to show that, while Dewey does distinguish successful, satisfactory, or "complete", experience from "incomplete" experience, he does not adequately assimilate, nor, on the basis of this assimilation, distinguish in degree, the esthetic from the practical and the intellectual. That the latter are in fact distinct requires an analysis of them as kinds of experience.

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"REFLECTION"

I

IN THE Oxford New English Dictionary "reflection" is defined under the philosophical category as follows: "The mode, operation, or faculty by which the mind has knowledge of itself and its operations, or by which it deals with the ideas received from sensation and perception." The first use of reflection in this sense is attributed to John Locke (1690). The definition is inaccurate, and the attribution to Locke is erroneous. Reflection as a philosophical term denoting "a faculty by which the mind has knowledge of itself"

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the end of effort) and enjoyments indulged to submerge and compensate work. (*Cf. Human Nature and Conduct,* Modern Library edition, 143 ff. Perhaps the best statement of the parallel separation of means and end, practice and enjoyment, laborer and master, is *Experience and Nature,* Ch. ix.) That the esthetic or complete experience is also the ethically desirable experience is indicated further in Dewey's consideration of art as the "complete culmination of nature", "an event in which nature otherwise partial and incomplete comes fully to itself" (*Experience and Nature* 358). Finally, that the esthetic is the ethically ideal is suggested by Dewey's use of the principle of "means-end" as the norm in both esthetic and ethical contexts. (For its statement in the ethical context see *Theory of Valuation* 23.)

So far as I can find Dewey does not distinguish the ethical and the esthetic aspects of the means-end concept, nor indicate their relation. An acceptable view might be that in the esthetic orientation means-end designates the elements of the individual, unique, esthetic experience, whereas in the ethical context the means and end involved are capable of symbolic representation and thus comparable with similar elements in other experiences; the function of intelligence in esthetic experience being to concentrate the elements of this particular experience in a self-contained whole, the function of intelligence in the ethical experience to make the end of the particular situation harmonious with the ends of other experiences. One might then state as the function of ethical inquiry to determine whether a given experience, involving a certain means-end, should exist, and the function of esthetic creation to perfect the internal relations of that experience when it had been ethically approved. But Dewey does not offer such an analysis, and I suspect that he would disallow this clear distinction between moral and esthetic activities which is involved in the distinguishing of the ethical and esthetic integration of means-end.

is much older than Locke's *Essay*. Reflection as a philosophical term denoting a faculty "by which the mind deals with the ideas received from sensation and perception" is new in the vocabulary of Locke. Reflection was a term which Locke found ready for his use. He did not change its traditional meaning. He did, however, associate it with his own ideas of sensation and the *tabula rasa,* and by this association he gave the term a new significance.

In effect, there were two currents of ethical thought in England to which the term reflection was important. The traditional use of the word was that of the Intellectualists. For them reflection signified an admonitory, intellectual force which administered and witnessed the activities of the mind in accordance with the innate ideas. On the other hand, Locke and his followers adapted the word to the psychology of the *tabula rasa,* and for them reflection signified a creative, as well as administrative, intellectual force whose function it was to impose order upon the chaos of sense-impressions and to extract from the sense-impressions the generalizations upon which they depended to the exclusion of innate ideas. The one is an idealistic, the other a materialistic, conception.

Kenneth MacLean, in his study of Locke's influence in eighteenth-century English literature, quotes repetitions of Locke's definition of reflection from Blackmore, Akenside, Thomson, and Goldsmith. In each quotation it is clear that the poet had the terminology of Locke in mind. In his reference to Bishop Joseph Butler, however, it is apparent that Mr. MacLean was not aware that there were more conceptions of reflection than one.[1] He seems to have assumed that Locke made the idea of reflection of whole cloth and that any use of it in eighteenth-century English literature is attributable to his influence.

II

The influence which Locke's use of reflection had on later writers was not a matter of terminology. It was rather a matter of the lay versus the ecclesiastical ethics. By his use of sensation and reflection as the only sources of human knowledge he prepared the way for systems of ethics derived entirely from experience and entirely independent of revelation. Locke did not pursue the ethical implications of his doctrine, for he preferred to derive all ethics from revelation; but his successors did pursue it.

Such a system of ethics first appears in extended form in the work of William Wollaston. For Wollaston, the vehicle of moral judgments was reason; reason, he said, is a power by which, given a clear statement of any particular question, man can resolve any moral

[1] *John Locke and English Literature of the Eighteenth Century* (New Haven, Yale University Press, 1936) 61-62.

issue.[2] Reason operates in terms of "immediate" and "abstract" ideas,[3] and in these terms he expresses a distinction very similar to that of Locke between sensation and reflection. Without immediate ideas, he says, the mind could not operate at all; without abstract ideas there could be no generalization and application of one idea to another.[4] Wollaston established the general ideas developed by reflection as a foundation for an ethical theory.

> It cannot be amiss to note *further,* that tho a man, who truly uses his rational powers, has abstract ideas obtained by reflection; out of these frames to himself general truths, or apprehends the strength of such, and admits them, when they occur to him; by these, as by so many standards, measures and judges of things; and takes care to have the materials, which he makes use of in reasoning, to be rivetted and compacted together by them: yet by a *habit* of reasoning he may come to serve himself of them and apply them so quick, that he himself shall scarce observe it.[5]

A development in ethics of the Lockian ideas of reflection appeared in the "Preliminary Dissertation" to William King's *Origin of Evil* in 1732; it was written by the Reverend John Gay. The author begins with a criticism of Shaftesbury on the ground that his "moral sense" is simply proposed, without proof, to remedy the default of other attempts to establish a criterion of virtue.

> The moral Sense and Public Affection he supposes to be planted in us like *Instincts,* independent of Reason, and previous to any Instruction. . . . But this Account seems still insufficient, rather cutting the Knot than untying it, and if it is not akin to the Doctrine of Innate Ideas, yet I think it relishes too much of that of Occult Qualities.[6]

This criticism is clearly based on Locke, and the essay may be said in general to be a selfconscious extension of Lockian principles into ethical theory. Moral ideas, the author says, "are all *mixed Modes,* or compounded Ideas arbitrarily put together".[7] This is good Lockian terminology. These compounded moral ideas, or mixed modes, may all, Gay says, be resolved into reason, selflove, and habit.[8] The central emphasis of the essay is identical with the central implication of Locke's psychology for all moral theory: the foundation of morality

[2] *The Religion of Nature Delineated* (London, 1725) 45.
[3] *Ibid.* 41. [4] *Ibid.* [5] *Ibid.* 46.
[6] Tr. and ed. Edmund Law, 3rd edition, Cambridge, 1739, xxx. Gay's dissertation was first printed in the second edition of Law's translation (1732) and was reprinted in all editions thereafter.
[7] *Ibid.* xxvii; see also liv.
[8] *Ibid.* xxxi: "Our Approbation of Morality, and all Affections whatsoever, are finally resolvable into *Reason* pointing out *private Happiness,* and are conversant only about things apprehended to be means tending to this end; and that whenever this end is not perceived, they are to be accounted for from the *Association of Ideas,* and may properly enough be called Habits."

is experience, and no moral principles exist that are not derived, directly or indirectly, from experience.

It is necessary in order to solve the principal Actions of human Life to suppose a *Moral Sense* (or what is signify'd by that Name) and also *publick Affections;* but I deny that this Moral Sense, or these publick Affections, are innate, or *implanted* in us. They are acquired either from our own *Observation* or the *Imitation* of others.[9]

The ultimate development of Locke's suggestions as they apply to ethics is to be found in the work of David Hume. In his *An Enquiry Concerning Human Understanding,* Hume bases his theory of the origin of ideas on Locke's theories, but he refines and elaborates it to obviate some confusions that he thought detrimental to the original statement. To avoid confusion in the use of the word "idea", Hume limited it to designate only concepts of the order produced by the operation of reflection; "thoughts" and "ideas" he used as synonymous terms. The products of the operation of sensation he called "impressions".[10] This distinction between "ideas" and "impressions" seemed to Hume to dispel much of the difficulty into which Locke and his critics had fallen.

Hume further emphasized the fundamental importance of impressions, of sensation. No idea may be found, he insisted, which cannot be resolved into the basic impressions from which it was derived. For example, the idea of divinity is easily demonstrated to be nothing more than a limitless extension in man's imagination of his own qualities of goodness and wisdom.[11] By the same process, the generalization of particular affections, the criteria of morality are established. All men experience the same approbation of any action which is useful and pleasant;[12] therefore useful and pleasant acts are the general type which reflection fixes upon as the standard of morality.

[9] *Ibid.* lv. See C. M. Perry, *The Genesis and Operation of Moral Judgments: A Study of British Theories from Hobbes to Adam Smith* (University of Chicago Abstracts of Theses, Humanistic Series), V (1926-27) 27-32.

[10] *Hume's Enquiries* (ed. L. A. Selby-Bigge, Oxford, 1936) 18.

[11] *Ibid.* 19: "When we analyze our thoughts or ideas, however compounded or sublime, we always find that they resolve themselves into such simple ideas as were copied from a precedent feeling or sentiment. Even those ideas, which, at first view, seem the most wide of this origin, are found, upon a nearer scrutiny, to be derived from it. The idea of God, as meaning an infinitely intelligent, wise, and good Being, arises from reflecting on the operations of our own mind, and augmenting, without limit, those qualities of goodness and wisdom. We may prosecute this enquiry to what length we please; where we shall always find, that every idea which we examine is copied from a similar expression." *Cf.* Locke, *An Essay Concerning the Human Understanding* (ed. A. C. Fraser, 2 vols., Oxford Press, 1894) I 418-19 and II 66; also Addison, *The Spectator,* Number 531. See MacLean, *op. cit.* 147-48.

[12] Hume, *op. cit.* 276.

On this foundation was built utilitarianism, the first comprehensive theory of ethics in English philosophy established in entire independence of revelation and the innate ideas. This is the most significant manifestation of Locke's influence in the ethical theory of eighteenth-century England.

III

Quite apart from reflection as it was employed, in association with the idea of the *tabula rasa,* by Locke and his followers, there was another use of it commonplace in the traditional and orthodox philosophy of England. As early as 1597 William Perkins had made a definition of reflection similar to that of Locke,[13] and it is significant that Perkins coupled reflection with the word "conscience".

Immanuel Bourne, whose treatise is based upon that of Perkins, enlarged upon the idea of conscience as reflection and expanded the idea of reflection as a consciousness of the inward activity of the mind.[14] Both Perkins and Bourne assume that the standards, the criteria by which reflection operates, are absolute. There is no question as to the sources of the material upon which reflection works. The innate and absolute nature of what Locke was to designate as reflective ideas was assumed.

A more selfconscious statement of the principle of reflection from the traditional point of view appears in Ralph Cudworth's treatise of morality. Cudworth's purpose was to emphasize his opinion that the mind can operate independently, without the aid of the senses.

> The essence of nothing is reached unto by the senses looking outward, but by the mind's looking inward into itself. That which wholly looks

[13] *A Discourse of Conscience* (2nd ed., Printed by John Legat, Printer to the University of Cambridge, 1597) 77: "For there be two actions of the understanding, the one is simple, which barely conceiveth or thinketh this or that: the other is *a reflecting* or doubling of the former, whereby a man conceives and thinks with himselfe what he thinks. And this action properly pertaines to the conscience. The minde thinks a thought, now conscience goes beyond the minde, and knows what the minde thinks; so as if a man would goe about to hide his sinneful thoughts from God, his conscience as it were another person within him, shall discover all. By meanes of this second action conscience may beare witness even of thoughts, and from hence also it seems to borrow his name, because conscience is a *science* or knowledge ioyned with an other knowledge: for by it I conceive and know what I know."

[14] *The Anatomie of Conscience* (London, 1623) 7-8: "Some later Divines doe thinke it to be a office or function of the Soule, set as an *Arbitrator,* not onely to examine, but to give evidence and judge of particular actions between God and man. For as that office of the soule, by which a man doth thinke or imagine, is called *minde;* and that, by which a man discusseth and discerneth things conceived, is called the *reason* or *judgment;* Even so, that function or office of the soule, whereby a man (upon enquiry) is certified, that the things which he hath done are good or evill, is called conscience. And this office of Conscience, the most affirm to be a divine facultie or power in the soule, working upon itself by reflection. For thus

abroad outward upon its object, is not one with that which it perceives, but is at a distance from it, and therefore cannot know and comprehend it; but knowledge and intellection doth not merely prospicere, look out upon a thing at a distance, but makes an inward reflection upon the thing it knows, and according to the etymon of the word, intellectus, 'the intellect', doth in interioribus legere, 'read inward characters written within itself', and intellectually comprehend its object within itself, and is the same with it. For though this may be conceived to be true of individual things known (although the mind understands them also under abstract notions of its own) yet, at least in Aristotle's sense, it is unquestionably true, . . . 'In abstract things themselves', which are the primary objects of science, 'the intellect and the thing known are really one and the same'. For those ideas or objects of intellection are nothing else but modifications of the mind itself.[35]

Another statement of the moral function of reflection is that of Fénelon. For him moral development seemed to consist of practice in the application of innate generalizations to particular situations.

I have yet universal and immutable Notions, which are the Rule and Standard of all my Judgments; insomuch, that I cannot judge of any Thing but by consulting them; nor am I free to judge contrary to what they

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the Conscience, by cooperation and help of other faculties in the soule produceth severall effects. . . . Even as in a looking-glasse a man seeth his owne face by reflection, and discerneth the beauty or deformity of that, and the eye seeth itselfe, which else it cannot: So, in Conscience, which is the eye and glasse of the Soule, the Soule beholds her selfe, and sees her owne beauty or deformity, together with the print or stamp of every action which it hath committed, eyther good or evill, giving evidence to God and to her selfe, and judging eyther for us or against us, as the deed requires." See also Robert Burton, *The Anatomy of Melancholy* (Philadelphia, Lippincott, 1868) 106: "'Understanding is a power of the soul, by which we perceive, know, remember, and judge as well singulars as universals, having certain innate notices or beginnings of arts, a reflecting action, by which it judgeth of his own doings, and examines them.' Out of this definition (besides his chief office, which is to apprehend, judge all that he performs, without the help of any instruments or organs) three differences appear betwixt a man and a beast. At first, the sense only comprehends singularities, the understanding universalities. Secondly, the sense hath no innate notions. Thirdly, brutes cannot reflect upon themselves."

[35] *The True Intellectual System of the Universe . . . with a treatise concerning Eternal and Immutable Morality* (3 vols., London, 1845) III 566. It is worth notice that Locke may have had access to Cudworth's treatise on morality, though it was not published until 1731. The MS was finished, or nearly finished, in 1665. Cudworth's daughter Damaris, who became Lady Masham, was a close friend of Locke from the time of their first meeting in London in 1682 (H. R. Fox Bourne, *The Life of John Locke*, London, Henry S. King and Co., 1876 I 474-78) until he died in her house at Oates in 1704. That one MS of the *Eternal and Immutable Morality* ultimately came into her possession is testified by the fact that her son Francis Masham, who was only two years old when his grandfather Cudworth died, had one; it was he who sent the MS to Edward Chandler, Bishop of Durham, in 1731. (See Thomas Birch in his preface to the *Works* of Ralph Cudworth, I xiii-xv and xxvi). It is important to remember, however, that Locke did not live at Oates before 1691, and that his *Essay* was published in 1690.

represent to me. . . . 'Tis something that inspires me every moment, provided I hearken to it, and I never err or mistake except when I am not attentive to it. What inspires me would for ever preserve me from Error, if I were docile, and acted without Precipitation: For that inward inspiration would teach me to judge aright of Things within my reach, and about which I have occasion to form a Judgment. . . . That inward Rule is what I call My REASON; But I speak of *My REASON* without penetrating into the Extent of those Words, as I speak of NATURE and INSTINCT, without knowing what those expressions mean.[16]

It was in Fénelon's sense that Shaftesbury identified reflection with conscience; conscience, he said, is the feeling of remorse which accompanies reflection upon "any unjust action or behavior which he [one] knows to be naturally odious and ill-deserving."[17] The likes and dislikes of conscience are not determined by experience, but by the invariable laws of human nature.

In Bishop Joseph Butler's theory reflection and conscience are the same.[18] Throughout his works Butler uses the words side by side, as a sort of tautological doublet. He defines reflection as follows:

There is a principle of reflection in men, by which they distinguish between, approve and disapprove their own actions. We are plainly constituted such sort of creatures as to reflect upon our own nature. The mind can take a view of what passes within itself, its propensions, aversions, passions, affections, as respecting such objects, and in such degrees; and of the sev-

[16] *A Demonstration of the Existence and Attributes of God* (tr. Abel Boyer, London, 1713) 136-38.

[17] *Characteristics* (ed. J. M. Robertson, 2 vols., London, Grant Richards, 1900) I 305: "In whatever manner we consider of this, we shall find still, that every reasoning or reflecting creature is by his nature forced to endure the review of his own mind and actions, and to have representations of himself and his inward affairs constantly passing before him, obvious to him, and revolving in his mind. Now as nothing can be more grievous than this is to one who has thrown off natural affection, so nothing can be more delightful to one who has preserved it with sincerity.

"There are two things which to a rational creature must be horridly offensive and grievous, viz. 'To have the reflection in his mind of any unjust action of behaviour which he knows to be prejudicial to his own interests or happiness'.

"The former of these is alone properly called Conscience, whether in a moral or religious sense. For to have awe and terror of the Deity does not, of itself, imply conscience. No one is esteemed the more conscientious for the fear of evil spirits, conjurations, enchantments, or whatever may proceed from any unjust, capricious, or devilish nature. Now to fear God any otherwise than as in consequence of some justly blamable and imputable act, is to fear a devilish nature, not a divine one. Nor does the fear of hell or a thousand terrors of the Deity imply conscience, unless where there is an apprehension of what is wrong, odious, morally deformed, and ill-deserving. And where this is the case, there conscience must have effect, and punishment of necessity be apprehended, even though it be not expressly threatened."

[18] *Works* (ed. W. E. Gladstone, 2 vols., Oxford, Clarendon Press, 1896) II 41-42.

eral actions consequent thereupon. In this survey it approves of one, disapproves of another, and towards a third is affected in neither of these ways, but is quite indifferent.[19]

Butler quotes St. Augustine as the authority for his definition.[20] He also refers to Epictetus in connection with the word.[21]

Kenneth MacLean notices that Bishop Butler believed that the power of reflection would be preserved after death, even though that of sensation be destroyed, and assumes that Butler's conception of reflection came from Locke.[22] He expresses his opinion that Butler believed virtue to be unnatural to man and emphasized the "possibility and necessity of developing a rational morality of principles to make up for the want of an instinctive morality".[23] It is true that Butler thought training helpful to morality; his sermon preached to the children of the charity schools of London in 1745 is on this theme. But the idea is a universal commonplace; it can hardly be regarded as identifying Butler with the school of Locke.

Butler was aware of the Lockian ideas. Sensation and reflection appear together in the *Analogy,* but they are somewhat changed, and the relationship between them is not clearly defined. At the outset Butler qualifies sensation by sanctifying it: the senses, Butler says, "are . . . instruments of our receiving such ideas from external objects, as the Author of nature appointed those external objects to be the occasions of exciting in us".[24] In this sense, sensation itself becomes a spiritual faculty.

> Human creatures exist at present in two states of life and perception, greatly different from each other; each of which has its own peculiar laws, and its own peculiar enjoyments and sufferings. When any of our senses are affected or appetites gratified with the objects of them, we may be said to exist or live in a state of sensation. When none of our senses are affected or appetites gratified, and yet we perceive, and reason, and act; we may be said to exist or live in a state of reflection. Now it is by no means certain, that any thing which is dissolved by death, is in any way necessary to the living being in this its state of reflection, after ideas are gained.[25]

[19] *Ibid.*

[20] *Ibid.* 234 and note *a:* "St. Austin observes, Amor ipse ordinate amandus est, quo bene amatur quod amandum est, ut sit in nobis virtus, qua vivitur bene. *I.e. The affection which we rightly have for what is lovely, must* ordinate *justly;* (must) *in due manner and proportion, become the object of a new affection, or be itself beloved, in order to our being endued with that virtue which is the principle of a good life.* De. Civ. Dei. I. xv. c. 22."

[21] *Ibid.* I 398 and note. *Cf.* L. Carrau, "La philosophie de Butler", *Revue Philosophique* XXI (1886) 150-51.

[22] *Op. cit.* 61-62. See also W. H. Weeda, *Joseph Butler als Zedekundige beschouwd, en gewaardeerd* (Utrecht, 1899) 62: "Like Shaftesbury, Butler borrowed his conception of reflection from Locke."

[23] *Op. cit.* 27.

[24] *Op. cit.* I 34. See MacLean, *op. cit.* 52.

[25] *Op. cit.* I 39.

In this passage the assumption seems to have been made that reflection is dependent upon and is informed by sensation. There is no suggestion, however, that the *criteria* of reflection depend upon experience. Butler's doctrine is as easily reconcilable with that of Perkins as with that of Locke. It is a mistake to attribute Butler's use of reflection to the influence of Locke.

IV

The term "reflection" was used in sixteenth-century English books to describe the faculty by which man regards the working of his own mind. It is therefore incorrect to attribute to Locke the first use of the term in this sense. Before the publication of Locke's *Essay*, however, reflection was generally thought of as based exclusively upon innate general principles; it was not a creative faculty. In Locke's philosophy reflection, working exclusively with the particular data of sensation, derived its own general principles. For him it was a creative faculty.

In his study of Locke's influence in eighteenth-century English literature Mr. MacLean failed to distinguish these two conceptions of reflection. He therefore committed the blunder of assigning a Lockian source to Bishop Butler's traditional use of the term. He failed, moreover, to discern the most important effect of Locke's theory on English ethical thought: it was in Locke's combination of sensation and reflection that Wollaston and Gay found the initial suggestion for a system of ethics independent of revelation and innate ideas, and that Hume found the basis for his excursion into the principles of utilitarianism.

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REVIEWS OF BOOKS

Realms of Being. By GEORGE SANTAYANA. (One-Volume Edition. With a new introduction by the Author.) New York, Charles Sribner's Sons, 1942. Pp. xxxii, 862.

It is a great advantage for the reader of Santayana to have this one-volume edition of *Realms of Being.* I suspect that most people, like myself, read each of the four separate books devoted to a single Realm as it was published at intervals of some years, and never would have read them all consecutively if the present edition had not appeared. For, superficially at least, there is very little tight, organic system in this work; each book, chapter, page, even each sentence, possesses a certain independent value, like a jewel with its own luster and charm; and one can begin Santayana anywhere, put him down, then take him up somewhere else and be amply rewarded, oftentimes without being aware of inconsecutiveness. Yet, personally, I would not have missed the experience of reading through the 854 pages of this book; their total impact is tremendous, something like that of a great, extended novel, such as *War and Peace* or *Les Misérables.* And what a marvellous tapestry of interwoven thoughts and images is here presented to the reader! There has been nothing equal to it in our generation. It is almost a miracle that such a work could have been written at all in our times of vulgarity, turmoil, and one-sided emphasis on the pragmatic goods. Let us do Santayana the honor of being as critical as we will of his masterpiece, but let us not fail in gratitude for this priceless gift of the most cultivated mind using the English language as its medium of expression, or in praise for the single-mindedness that must have been necessary for its production.

Although this is a book of metaphysics, its value, being largely literary, even poetic, is partly independent of its literal truth. In this regard, it reminds one of Schopenhauer's *World as Will and Idea,* with which comparison is suggested on other counts. Yet I am sure that Santayana would wish us to judge it as metaphysics; and, if we do, then I for one find myself compelled to reject it, unless important modifications are introduced. All its basic metaphysical concepts seem to me either empty or untrue, as they stand. For consider the central conception of essence. A good case can be made out for the reality of universals, not as Platonically separate subsistents, but as stable factors in experience, around which the flux of events is deployed; yet Santayana's essences are not limited to universals, since they include the content of every intuition, in its complete uniqueness and individuality. For example, the visual landscape that meets my eyes at each moment (71), with all its overtones of feeling, is a

single essence. But how does such an essence differ from an existence? In vain does Santayana strive to distinguish them. And as regards the infinite number of other such essences supposed by Santayana to have being, how can we know that they are? If the answer is that at least we can imagine them, that the realm of the possible extends beyond the actual, my difficulty remains, for we can imagine only the abstract, while these essences are fully concrete. Considerations of this kind, which I should like to pursue further if space were available, prove, I believe, that essences are either indistinguishable from existences, when given in intuition, or else are universals in the traditional sense; in either case, they are not what Santayana intended them to be. Hence the 'precious doctrine of essence', as Strong called it, must be abandoned, and with it the realm of mere Being, contrasted with the realm of existence.

Consider, second, the conception of matter. If one examines what Santayana calls the indispensable properties of matter (203), only the first, which affirms the externality of substance to thought, would not apply just as well to a world of spirits as to a system of corporeal entities; and indeed there is much, perhaps the larger part, of what Santayana says about matter during the course of the book entitled The Realm of Matter, which any empirical idealist would find true. There is, indeed, a purely Aristotelian layer of meaning in his conception of matter, covering the individuality, contingency and variety of existence. But Santayana's conception is then thickened into the Democritean, which includes what he calls the 'presumable' properties of matter; and this stratum is, as he admits, hypothetical, and I should add, gratuitous; for all the facts from which it is deduced can be explained otherwise, as Berkeley and his followers have proved. The logical situation would be different if we had an intuition of matter; but since even the "shocks" and the experiences of seizing and ingesting food, which according to Santayana are foundational for the hypothesis of matter, occur within intuition, there is no necessary passage from them to matter. There are, moreover, brilliant pages of sceptical reflection in this book, testifying to his own wariness with regard to any concrete, even though 'scientific', theory of material existence.

Coming finally to the consideration of intuition, and omitting reluctantly any examination of the Realm of Truth, which for Santayana is only a segment of the Realm of Essence, we meet new difficulties. First, there is his belief that intuition, like matter, is never itself the object of intuition. But this is certainly a mistake, for in self-consciousness at least, one intuition intuits another. And if spirit—or intuition—were never intuited, it would remain, again like matter, a purely hypothetical entity, when as a fact, unlike matter, it is the

most certain reality. That Santayana failed to discern this is due, I believe, to his inability to recognize, as already indicated, that his concrete essences are indistinguishable from intuitions. Second, there is his denial of the efficacy of spirit. This is really astonishing in a philosopher who claims to interpret our experiences connected with the arts and crafts, where the efficacy of plan and intention is so overwhelmingly obvious. And is this denial, of all things, common sense?

As an offset to these serious defects of his metaphysical system, how often, in thought and phrase, does Santayana seem to be within a hair's breadth of the truth, so that if one modifies a concept ever so slightly or takes literally what he says metaphorically or conversely, the whole system clears up into rightness! For example, interpret his valuable concept of the psyche in such a way as to include mind as an efficacious factor, that is to say, understand it in its original Greek sense; or take literally, as Schopenhauer did, his similar concept of Will, which he uses metaphorically; restrict his essences in more orthodox fashion to universals; and there emerge a score of luminous analyses and as many more shrewd comments on the nature and range of knowledge, and a just sense of man's tragic relation to nature, which any philosopher of any school can welcome and find fruitful. That one can modify Santayana's thought in this way without destroying it, is itself interesting; and is due to the fact that his concepts have a certain literary largeness and vagueness, in the place of a technical narrowness and precision.

Most brilliant of all the books is the fourth, The Realm of Spirit, where, in a prose poem, Santayana relates the pilgrimage of man, seeking first happiness, then salvation in turning away from what he pregnantly calls distraction, in its three forms, the world, the flesh and the devil, to liberation and union with other spirits in the Eternal. Here also disagreement over metaphysical issues need not stand in the way of recognition of essential merit. Nowhere else, indeed, can one find so much worldly wisdom combined with insight into our dearest wishes, such a tender appreciation of the plight of the spirit of man, "torn away in tears from what it loves and beset everywhere by what it hates" (645), pathetically dependent upon the body and organized, it knows not why, into a political and economic system "of universal slave labor for the production of rubbish". This is, to be sure, a philosophy for the disillusioned—οἱ μὴ ἔχοντες ἐλπίδα—and cannot be accepted without reservation by men of faith or strenuous moral impulse, yet no one can fail to discover something of inspiration in its courageous facing of the facts of our human situation, and in its pervading serenity, born of intellectual dominion.

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The Theory of Motion in Plato's Later Dialogues. By J. B. SKEMP (Cambridge Classical Studies) Cambridge, at the University Press; New York, The Macmillan Company. 1942. Pp. xvi, 124.

In the dialogues later than the *Republic* we find Plato devoting more and more attention to the various aspects of 'Change'. He is no longer exclusively concerned with the eternal, unchanging Ideas but anxious to clarify the relationship between the sphere of Rest which is represented by the Ideas and that of Movement—for 'movement' (κίνησις) is the Greek term which covers the whole field of changes and processes. This phase of Plato's philosophy has perhaps never been quite adequately appreciated and Mr. Skemp rightly points out that the first to ignore it was Aristotle—at least the Aristotle of the *Metaphysics* whose contention that the Ideas are unable to affect the world of Becoming seems unfair to Plato's efforts to trace 'movements' to a source quite different from the Ideas.

Mr. Skemp's book may be reduced to three fundamental theses: (1) For Plato, the source of movements is the Soul which is as real and as eternal as the Forms, but is not itself conceived as a Form. (2) Each of the later dialogues adds some new and important feature or features to the Platonic theory of changes; the *Timaeus* gives us the fullest picture of the world of movements, Book X of the *Laws* a 'pedagogical' summary. (3) Along with incorporating the 'movements' in his own system Plato examines, revises, and incorporates important motifs of earlier, *i.e.* Presocratic thought; for, save for Parmenides and, probably Pythagoras, everything that the Presocratics had said belongs for Plato under the heading of 'movement' and needs to be put in its place—its place in a much larger maturer, and more complex system. These three theses are perfectly sound. We may argue about details. As regards the first it may be mentioned that in the last part of the *Phaedrus* Plato does go to the length of recognizing 'forms' or 'types' (εἴδη, doubtless used in the technical sense) of souls but indeed not *a* form of Soul. I wished Mr. Skemp had looked at the passages; but his position is correct. The second thesis is admirably developed. Mr. Skemp confines—quite rightly—Plato's interest in movements to his later dialogues but recognizes two exceptions, the *Cratylus* and the *Phaedrus*. This will be grist to the mill of those who regard these dialogues as too late, but Mr. Skemp is cautious and sticks to the orthodox view.

The third thesis is unassailable in itself, but Mr. Skemp does not always succeed in identifying the particular Presocratic philosopher whose thought Plato is assimilating. He makes a good case for Plato's interest in Alcmaeon, a somewhat mysterious but evidently important thinker, but uses the name of Empedocles rather too freely. That the antagonism between Reason and Necessity in the *Timaeus* is the

Platonic version of the antagonism between Love and Strife in Empedocles is at best a possibility. On the other hand, Democritus gets less than his due, for it is now unfortunately the custom either to ignore or reject Ingeborg Hammer Jensen's proofs for Plato's acquaintance with Democritus' theories. A new investigation of the subject would be welcome; at present I am inclined to think that large sections of the *Timaeus* show the influence of Democritus and are atomistic in conception—with the important difference that Plato puts atomism on a new, mathematical basis.

The chief value of the book lies in the fact that it shows precisely *where* Plato carries on the philosophical speculations of the Presocratics. Ever since Aristotle and Theophrastus they have been treated as his precursors, and yet it is no secret (and has been emphasized especially by Professor Jaeger) that Plato's early thought is much closer to Solon, Pindar, Attic tragedy, and Thucydides than to the Presocratic physicists. Mr. Skemp shows us where to look for real continuity between the Presocratics and Plato.

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The Seventeenth Century Background. Studies in the Thought of the Age in Relation to Poetry and Religion. By BASIL WILLEY. London, Chatto & Windus, 1942. Pp. viii, 316. (Columbia University Press, New York)

The value of this account of the changing climate of English philosophical opinion between Bacon and Locke, and of the chilling effect upon poetry and religion of the substitution of the "facts" of mechanico-materialistic explanations for the "values" of the mediaeval synthesis, is suggested by the publication of this second (and unchanged) impression, the original having appeared in 1934. There exists no more charming and informative sketch of that quiet seventeenth century backwater (isolated from Milton's "troubled sea of noises and hoarse disputes") which leads from Bacon's confident (though slightly premature) segregation of the spiritual and the natural, and the "universal consent" of Herbert of Cherbury, through the amphibious sensibility of Browne, the unavailing Cambridge synthesis of neo-Platonism and Cartesianism, and the somewhat gypsy-like scholarship of Glanvill, to Locke and the placidity of the Augustans. Mr. Willey's analysis of the ideas of such figures is a welcome addition to the history of English thought. It is true that he is chiefly concerned with men of no great philosophical weight; but his book is addressed to students of literature rather than professional philosophers, and he delicately indicates the intellectual significance of much that we had tended to regard as of merely antiquarian interest.

That the current of ideas with which he deals is, however, a backwater throughout most of the seventeenth century—though constituting a salient feature of its closing decades and of the eighteenth century background—is suggested not merely by what we have lately been taught to think of the rising preachers, the levelling debaters, and the mystical communists of the period, but by the difficulty Mr. Willey seems to experience in keeping *Paradise Lost* in focus against this subdued corner of the seventeenth century scene. The student of literature (who may also, of course, be a student of philosophy) will regard "The Heroic Poem in a Scientific Age" as a key chapter; and he is likely to conclude that for the author of that not altogether unsuccessful epic the problems which confronted the poet as the universe ceased to be heroic and mysterious must have been offset by the unphilosophical and illogical convictions which made most of the century so vigorously tempestuous and to which Mr. Willey, like Browne and the Platonists, seems to prefer to pay as little attention as possible. He has given us a delightful insight into the wistful whimsicality of those who lived in divided and distinguished worlds, and a valuable introduction to the eighteenth century in his nice treatment of rationalists like Herbert and Platonists like John Smith; but it is surely somewhat strange that the index of a book so entitled should contain no entry for Puritanism.

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The Destiny of Western Man. By W. T. STACE. New York, Reynal and Hitchcock, 1942. Pp. xi, 322.

According to Stace, two irreconcilable civilizations are today locked in life and death struggle: the Greek-Christian and the Totalitarian. The former is based on the doctrine of the primacy of reason (as elaborated by Greek classical philosophy) and sympathy (as established in the teachings of Christ). This doctrine implies the principle of the infinite value of the individual, and that in turn yields the philosophical foundation for democracy. Plato and Christ thus appear not only as the "founders of western civilization" but also as the spiritual fathers of modern democracy. In contrast, Totalitarianism is based on the doctrine of the primacy of will and self-assertion; it regards the individual chiefly as a means for the achievement of the higher ends of the state or society (which is hypostatized as an organic entity above the individuals), employing this doctrine on behalf of aggressive and destructive goals. Schopenhauer and Nietzsche are the spiritual fathers of Totalitarianism.

Stace attempts to demonstrate the truth of Greek-Christian and the falsity of Totalitarian civilization according to an objective rational

criterion, the concept of the "good life". Both civilizations, he finds, aim at the realization of the good (that is, the healthy, happy, satisfactory) life, but whereas the Greek-Christian conception gives their proper place and functioning to *all* elements of human nature, the Totalitarian conception exaggerates and releases *some* of these elements at the expense of the others, and thus inevitably leads to a destruction or at least perversion of the complete human personality. The ideas of western civilization are therefore better on rational grounds, and not merely because they happen to be *our* ideas.

Stace's book has a brilliant lucidity; throughout the argument, he fights on the right side and for the right ideas and principles. But precisely because of that, and because of the fact that the rational justification of western civilization has been one of the most disputed factors in the struggle against Totalitarianism, we must draw attention to the points that might weaken or even invalidate that argument. Since it is impossible, in the space of a review, to take up all the issues involved, we shall limit ourselves to a few fundamentals.

Stace attacks the "philosophy" and the moral conception of Totalitarianism and deliberately omits social and economic issues. This would be a perfectly legitimate procedure if Totalitarianism possessed a philosophy and moral conception in the same sense in which western civilization does. But Stace himself emphasizes that Totalitarianism lacks "any clear and consistent set of doctrines", that it manufactures its doctrines *ad hoc*, according to the requirements of the changing political constellation. There is, of course, a general tendency underlying this procedure, but it can only be derived from and explained by an analysis of the social forces with which Totalitarianism has from the beginning associated itself. The New Order which is aimed at is not a new civilization but the violent conversion of civilization into a state of integral enslavement and regimentation. This policy is the result, not of some irrationalistic philosophy, but of the frightfully rational mechanisms which governed the economic and social development in Germany and Italy since the first World War.

The struggle against Totalitarianism is a struggle within "Greek-Christian civilization", against the destructive and aggressive forces which this civilization has time and again overcome. To treat Totalitarianism as a new civilization means to credit it with exactly what it wishes to be credited with. Hitler has frequently said that his goal, too, is the realization of the "good life", and that the final triumph of his New Order would initiate the "proper" development of human nature. That this claim will not be fulfilled, is not due to the philosophical inconsistencies and fallacies of his system but to the contradictions inherent in the imperalistic "command economy". These

contradictions will necessitate ever further conquest and ever harsher oppression, and prevent any future lifting of the restraint imposed upon society.

In order to carry through his philosophical refutation of Totalitarianism, Stace is compelled to transform what are the purely pragmatic values of Totalitarianism into a fairly consistent philosophy. Small wonder that his presentation of this philosophy does not always correspond to the facts. For example, he elevates the organic conception of society to the position of the highest principle of Totalitarianism, whereas in fact this conception plays a definitely inferior role in National Socialist ideology and is often repudiated by prominent spokesmen. Moreover, he endeavors to combine the organic conception of society with the political theory of Hegel, when, in reality, the latter was chiefly directed against organicism and is incompatible with it. He holds that Schopenhauer and Nietzsche were mainly responsible for Totalitarian philosophy. But Schopenhauer's doctrine of the primacy of will is conditioned upon his interpretation of the world as a place of perennial suffering, and it terminates in the postulate of the annihilation of will—conceptions which are strikingly opposed to the Totalitarian outlook. Moreover, according to Schopenhauer, sympathy is the only legitimate motive of action, and sympathy Stace counts among the main concepts of Greek-Christian civilization. Nietzsche's case is more difficult to interpret. It is doubtless true that he influenced the German movement toward National Socialism, but the extreme individualism of his philosophy remains hostile to any kind of Totalitarianism, and the idea of an entirely regimented and coördinated society was abhorrent to him. On the other hand, Stace minimizes or omits doctrines which form the very core of Totalitarian ideology and which are not so easily discarded because they lie closest to the material interests that determine the course of National Socialist policy. The doctrine of racial imperialism, of the "proletarian nations", and antisemitism are examples.

Inadequate analysis of Totalitarianism has its counterpart in oversimplification of the compound term "Greek-Christian civilization". This concept is held together chiefly by the (Greek) idea of reason and its historical association with the (Christian) idea of sympathy. According to Stace, they form the center of the "cluster of ideas" which feed western civilization and the philosophy of democracy. True, the idea of reason contains the clue to an understanding of western civilization, but it seems highly questionable whether the latter can be understood by stretching the Greek pattern of reason to cover the centuries from late Ancient to late modern society. Since the sixteenth century, the idea of reason necessarily assumed

features entirely foreign to the Greek conception, features which stem from totally different sources. The idea and the realization of reason were oriented to technological conquest of the material world, and to the pragmatic and instrumentalistic conception of knowledge which Stace so vigorously attacks. Reason in Galileo, Bacon, and Descartes, in Machiavelli and Hobbes, in Luther and Calvin has very little to do with Greek philosophy and very much to do with the new social structure. Stace is of course aware of the essential difference, but in order to reconcile it with his unified picture of a Greek-Christian civilization, he follows Whitehead in attributing these new features to an "anti-rationalistic revolt" against the exaggerated claims of rationalism. The idea that the birth and growth of modern physical science and of the "scientific attitude" was due to a pervasive anti-rationalistic revolt is certainly appealing, but the most decisive developments of western civilization would then come under the sway of anti-rationalism, and Stace's rationalistic interpretation of the Greek-Christian world would break down. It seems more adequate to the facts, however, to abandon the attempt to cover modern society with the Platonic idea of reason and to acknowledge the specific rationality which permeated and still permeates this society. This rationality was from the beginning oriented to the domination and exploitation of the material and intellectual resources with the impulses of competitive self-assertion, elements which Stace seems all too readily to reserve to the philosophy of Totalitarianism.

Stace's picture of Greek-Christian civilization not only oversimplifies the facts but also obscures the historical roots of Totalitarianism and thereby impairs the understanding of its scope and aims. The sharp contrast between Greek-Christian and totalitarian civilization is weakened by the fact that Stace excludes from the former almost all the traits which would disturb his picture. Do Machiavelli, Bodin and Hobbes, Robespierre and De Maistre, Calvin and Loyola not belong to western civilization? But their inclusion would have destroyed Stace's contention that the philosophy of democracy follows "logically" from the Greek and Christian doctrine of man. Is it permissible to speak of Plato and Christ as the "two founders of western civilization" and as the spiritual ancestors of democracy? To be sure, Stace well knows the tendencies in Plato's philosophy which make for a totalitarian political theory, but he feels justified in disregarding them. He knows, moreover, that classical Greek thought was tied to the Greek slave society to such an extent that it could not possibly arrive at the idea of the infinite value of the individual *qua* individual. Stace helps himself out by saying that Greek rationalism planted the seed from which this idea necessarily

grew. The same device is used to derive the philosophy of modern democracy from the teachings of Christ—a device which makes the entire development from the first to the eighteenth century into a history of the realization of the democratic principle. According to Stace, the "ethos" of Greek-Christian civilization developed into the "democratic way of life" with "logical necessity". "It makes no difference whether the growth to full stature of the ethical idea of Europe took nineteen hundred, or only ninety years. The seed grows into the flower". This is the Hegelian philosophy of history without the Hegelian philosophy.

Here again, we do not argue from the standpoint of the "historical student" but for the issue's sake. The issue is the adequate understanding of Totalitarianism so that it can be fought with the best weapons in every field where it manifests itself. For such an understanding, it is imperative to know the roots of Totalitarianism in our civilization and the psychological and social forces which may feed Totalitarianism. Unfortunately, there is no "logical" necessity in the rise of democracy, and the powers which time and again tried to arrest its march knew that only too well. Unfortunately, too, the fight against democracy has also been an integral part of western civilization. In Stace's interpretation, Totalitarianism appears as an "outside" phenomenon of relatively recent date, confined to a special compound of ideas for which Schopenhauer and Nietzsche are chiefly responsible. In reality, however, Totalitarianism draws heavily from forces which, since the German Reformation, have frequently exploded the Greek-Christian form of civilization. Authoritarianism, terrorism, antisemitism, persecution of minorities have played an important part in almost every social movement since the sixteenth century in which a particular group utilized and manipulated the frustrated masses for the assertion of its special interest. Present-day Totalitarianism has released these forces to serve the most aggressive imperialism the world has ever known. The struggle against it cannot be interpreted as a struggle to refute Schopenhauer and Nietzsche.

HERBERT MARCUSE

INSTITUTE OF SOCIAL RESEARCH
NEW YORK, N.Y.

Schelling: The Ages of the World. Translated with an Introduction and Notes by FREDERICK DEWOLFE BOLMAN, JR. New York, Columbia University Press, 1942. Pp. xi, 251.

Shortly after that transition in his thought which was signalled in 1809 by his *Wesen der menschlichen Freiheit,* Schelling centered his reflections on problems connected with what he called *Die Weltalter.* From among various unpublished manuscripts bearing this caption K.F.A. Schelling selected for publication in his edition of his father's

Sämmtliche Werke the one which probably dates from about 1814. It is this version of *Die Weltalter,* in the form in which it is printed in the *Sämmtliche Werke,* that Dr. Bolman has now rendered available in English translation.

Schelling's essay comprises only a brief introduction and Book One, entitled "The Past". Thus it represents but a partial fulfillment of the project which he had in mind. Even so, it possesses high importance, as was explicitly pointed out by its first editor and as has since been recognized time and again by competent scholars. Its significance is to be found in its searching exploration of basic problems, though also in the light which it throws on the general course of Schelling's philosophical thought. It affords a key to much of what Schelling had to say when, after almost two decades of silence on philosophical themes (disregarding some lectures delivered in Erlangen, he developed a system of thought which would reconcile the religious consciousness and rational interpretation, faith and knowledge, Christianity and philosophy—a body of thought in which there would be provision not merely for a system of concepts but likewise for realities and existences; in which the omega of the conceptual order would be the alpha of the real order, namely the independent being who, through an act of freedom (not out of dialectical necessity) created a world. Now begins the era of "The Present"—an era inaugurated by that exercise of freedom on the part of man which religious writers refer to as "the fall," leading to conflicts and struggles that are real and not simply the dialectical play of concepts. Even within "The Present", however, we can divine the succeeding age, "The Future", in which, through the active concern of God, conflicts will have been resolved and the world will have reacquired its unification with the Divine.

Dr. Bolman has placed under substantial obligation to himself all those who must come to know Schelling's writings through the medium of an English translation. The translation which he presents, while capable of improvement at many points, is nevertheless on the whole highly meritorious. Unfortunately Dr. Bolman's concern respecting the internal structure of his sentences taken singly has too much overshadowed his concern that the continuity of Schelling's thought he brought out as clearly as possible; ofttimes something approaching more nearly to a "tissue paper translation" would have been desirable. The expression *unvordenkliche Entscheidung* he translates as "immemorial decision". Does not this fail to capture (or, most certainly, to express) Schelling's meaning? What demarcates *Die Weltalter* from the earlier writings of Schelling is in part the fact that it manifests the empiricism which in due course became even more prominent in Schelling, an empiricism connected with

Schelling's insistence on the principle of freedom as it applies alike to God and to man, and, in the case of the latter, to man in his relations both to God and to other existents. *Unvordenklich*, then, means not "immemorial" but "incapable of rational deduction", "incapable of being arrived at through pure or *a priori* thought". In a number of cases, such for example as the first two sentences of the last paragraph of the essay, desirable changes would occur to one almost at first blush.

Dr. Bolman's notes are in general quite helpful. His introductory essay leaves much to be desired. Too largely it falls back on Schelling's own expressions; too little does it seek to specify precisely what these really signify.

EDWARD L. SCHAUB

NORTHWESTERN UNIVERSITY

Major Trends in Jewish Mysticism. By GERSHOM G. SCHOLEM. The Hilda Stich Stroock Lectures, 4th series. Published for the Jewish Institute of Religion, New York City. Jerusalem, Schocken Publishing House, 1941. Pp. xv, 440.

The word Kabbalah evokes an immediate sense of mystery and marvel. This esoteric doctrine has deeply influenced the development of Judaism, and has fascinated not a few Christian students. It has had its savage opponents and its ardent apologists. But attack and defense alike have been based on inadequate knowledge. Some three thousand Kabbalistic texts have been printed; even larger is the number of works still in manuscript. To comprehend fully and evaluate fairly a mystical tradition extending over two millennia is possible only after an enormous amount of detailed philological and historical research.

Dr. Scholem is Professor of Jewish Mysticism at the Hebrew University, Jerusalem—the only scholar, to my knowledge, to occupy such a chair in any institution of learning. He has devoted twenty years to critical study in his field, and his numerous publications have made him the outstanding authority on the subject. Now, in a series of nine lectures, first delivered in 1938 at the Jewish Institute of Religion in New York, he has formulated his well matured conclusions. The presentation is so simple and clear that the utter novice enters with assurance into a new and confusing territory, so original that the most erudite will learn much from it. Voluminous notes provide a guide to the sources, many still unpublished.

A true scholar, Dr. Scholem is not content to assemble facts; he also tries to determine their significance. There are many incisive remarks about mysticism in general, its positive values, its dangers and pitfalls. With a substantial body of information, the reader gains

also an insight into the reasons which led the author to devote his life to this difficult and abstruse subject.

As the title indicates, the book is not a complete and detailed history of Jewish mysticism (for example, philosophic mystics in the neo-Platonic tradition, like ibn Gabirol, are barely mentioned) but a series of studies on its most important aspects. Dr. Scholem considers in turn the "Chariot"-contemplatives who date back to pre-Christian times and have some relationship with Gnosticism; the more moralistic and ascetic mystics of medieval Germany; the great efflorescence of Spanish Kabbalah in the 12th and 13th centuries; the revolution in Kabbalism in 16th century Palestine under the influence of Isaac Luria, and the antinomian and Messianic heresies that marked the decadence of the new trend; and finally the popular mystical movement called Hasidism, which arose among the Jews of eastern Europe in the 18th century and has not ceased to exist even in the present day. An introductory lecture discusses brilliantly the distinctive character of Jewish mysticism. Space does not permit an exposition of Dr. Scholem's stimulating ideas on the subject; but it is proper to note that the term Kabbalah does not include all manifestations of the mystical spirit in Judaism, but does include many matters not directly related to mystical experience or even to mystical theology.

This is an epoch making work on a little known subject, which the historian of religion must reckon with. Since Dr. Scholem's earlier publications have been in German and Hebrew, the appearance of this book in English (the translation, for the most part satisfactory, is by George Lichtheim) is particularly welcome.

BERNARD J. BAMBERGER

ALBANY, N.Y.

Reason and Intuition. By A. C. EWING. Annual Philosophical Lecture, Henriette Hertz Trust, British Academy, 1941. From the Proceedings of the British Academy, Vol. XXVII. London, Humphrey Milford, n.d. Pp. 43.

In this lecture Mr. Ewing defends the existence of intuition, or an immediate insight into truth, as an element of knowledge. His purpose is to refute the "disparagement of reason" which he thinks is implied by certain developments in modern science such as its rejection of metaphysics and more particularly by the positivist analysis of scientific method. With this tendency in science is connected, he thinks, an ethical naturalism or skepticism which, he fears, makes it impossible to discuss moral questions or to settle differences about ends except by violence.

Mr. Ewing's proof for the existence and indeed the necessity of intuition is substantially like Descartes', though it is given a considerably wider scope. A chain of reasoning must depend upon seeing that each step entails the next, and this perception cannot itself be inferential for, if it were, a new chain of reasoning would arise in which the implications would themselves have to be intuitively perceived. This argument holds good whether the inference is deductive or inductive, certain or only probable, and whether it refers to values or not. Mr. Ewing believes that four kinds of intuition can be distinguished, "those presupposed in deduction, those presupposed in induction, those presupposed in ethics, and those consisting in the apprehension of a whole as a whole" (11). Accordingly Mr. Ewing cannot accept coherence as the sole test of truth, for the coherence of propositions is itself dependent, like all inference, on intuition: at some point we "just see" that a proposition coheres with other propositions (24).

In one fundamental respect, however, Mr. Ewing parts company with Descartes: intuition is not infallible. The intuitionist "must abandon the claim to certainty and infallibility"; "we cannot claim that there is a distinctive state or act of mind, intuiting, which has the property of being always right" (25). There are real intuitions and merely apparent intuitions, and there need be "no psychological distinction between genuine and merely apparent intuitions" (26). By the latter statement Mr. Ewing means, I think, that a veridical intuition and one that is apparent but possibly false are indiscernible at the moment when they occur. In consequence intuition as a test of truth needs to be helped out, and this help can be derived, Mr. Ewing thinks, from coherence. It is a mere confusion to suppose that, because intuitions cannot be completely established by reasoning, they cannot be supported by reasoning (32). This support is supplied by coherence. "It is very doubtful whether we should ever have a right to accept it as *knowledge* that one proposition implied another on the ground that we saw this in one particular case unless we saw also that this implication was not peculiar to just this proposition but would also hold in other similar cases" (33).

But surely it must be evident at this point that Mr. Ewing's argument, at least so far as it has to do with a test of truth, is a logical circle. It is almost precisely parallel in its logical form to Mill's attempt to supplement hedonism with a qualitative standard for valuing pleasures. Pleasure is the standard of value but pleasure itself requires to be valued in terms of desirability or worthiness. Similarly Mr. Ewing first sets up intuition as the standard of coherence, because we must "just see" that propositions cohere before we can know that they do cohere. But not being certain that these

or other intuitions are veridical we test them by seeing whether they can be seen to cohere. But the only evidence of coherence is more intuitions, of which we can never be quite sure whether they are real or only apparent. Intuition is the test of coherence and coherence of intuition. Like Mill Mr. Ewing wants an impossibility: a test for the testing of tests. This kind of caution in philosophy leads to nothing but confusion, and it is still true, as Bacon said, that truth emerges from error more easily than from confusion. When Descartes thought that real intuitions had to be infallible if they were to be a test of truth he was absolutely right, and if there are no intuitions that are discernible as true, then intuition is not a test of truth. If there are intuitions that can be seen to be infallibly true, all Mr. Ewing or anybody else has to do is to say what they are. But this was long since tried and, one had hoped, had been given up.

GEORGE H. SABINE

CORNELL UNIVERSITY

DESCRIPTIVE NOTICES

From Copernicus to Einstein. By HANS REICHENBACH. Translated by RALPH B. WINN. New York, The Philosophical Library, 1942. Pp. 124.

Here is yet another monograph to be added to the already very extensive series of popular, non-mathematical expositions, of the Theory of Relativity. Aside from the circumstance that it displays Professor Reichenbach's unusual gifts for simple, attractive, yet precise delineation of difficult ideas, it adds little to what has been said on the same subject many times before. The translation is far from elegant, and there are more typographical errors than can easily be accounted for.

H. R. SMART

CORNELL UNIVERSITY

Essentials of a Liberal Education. By LUTHER D. EVANS. Boston, Ginn and Company, 1942. Pp. vi, 200.

The avowed purpose of the author is to give to the student a justification for scholarship in the liberal tradition which transcends the current vocational sanction for intellectual activity. To the teacher it should furnish an inspiration to reconsider his teaching purposes and procedures. Excellent advice is given the student concerning favorable conditions for study and the development of effective study habits. The important characteristics of the several divisions of knowledge are adequately presented without apparent bias. It is constantly emphasized that the mark of a liberal education is not only understanding but also a high sense of morality expressed in social sensitivity and action.

M. L. HULSE

CORNELL UNIVERSITY

Paths of Life: Preface to a World Religion. By CHARLES MORRIS. New York, Harper & Brothers, Publishers, 1942. Pp. 257.

Charles Morris undertakes an exhaustive classification and analysis of the major forms in which the religious quest may manifest itself. Assuming that human nature is constituted by three basic elements which religion must integrate and satisfy, he criticizes six historical religious attitudes for unduly emphasizing one of these three elements over the others. He then formulates a new faith, which, he supposes, will fully and equally satisfy each aspect of man's tripartite nature. Although an overly simplified theory of personality and an ill-defined value theory seem to make some of the conclusions arbitrary and insecure, these very difficulties, together with Mr. Morris's novel approach, contribute to an understanding of the fundamental issues involved in any attempt to supply the modern world with a new faith.

STUART M. BROWN, JR.

CORNELL UNIVERSITY

Experience and the Christian Faith. By HOWARD B. JEFFERSON. New York and Nashville, Abingdon-Cokesbury Press, 1942. Pp. 230.

Professor Jefferson is convinced that the way of truth in religion lies neither in humanistic liberalism nor in the new supernaturalistic theology,

but in a consistent combination of the essential elements of each. The first three quarters of the present book outline a theological method which he believes will supply the needed guidance in working out this combination; it emphasizes three principles—(1) the experimental or pragmatic approach to knowledge, (2) rational faith in a transcendent God who embodies supreme value and controls the world of nature, and (3) acceptance of the Christian tradition as revealing the essential content of this faith. The final chapter discusses the bearing of these principles on contemporary social problems, especially the problems of capitalism and labor, war and pacifism, marriage and the family, and the relation between religious ideals and political hopes and loyalties.

E. A. BURTT

CORNELL UNIVERSITY

Is Modern Culture Doomed? By ANDREW J. KRZENSINSKI. New York: The Devin-Adair Co., 1942. Pp. 158.

The base line of this book is Catholicism. Culture and Civilization are distinguished: the one internal, creative; the other, external and more or less fixed, and a part of the former. Two divergent cultures coexist in modern Western civilization: the traditional and Christian and the anti-traditional or materialistic. The former reaches its full stature in the form expounded by the Catholic Church: the glorification of God and the virtues attended therewith. The latter is anthropocentric, humanistic and epicurean. Even Protestantism with its emphasis upon individual freedom and autonomism has all along pointed toward the pernicious tendency away from truly Christian culture. A host of modern fashions betray the impending doom of materialism: racism, communism, scientism, nudism, pleasure-mad people, physical culturism, emptiness of spirit—tragic commentaries of our age. Yet optimism is in order since the present crises furnish good soil for God's opportunity.

VERGILIUS FERM

THE COLLEGE OF WOOSTER

The Judgment of the Nations. By CHRISTOPHER DAWSON. New York, Sheed and Ward, 1942. Pp. 222.

One might guess that the central thesis of this book is that the present international struggle is the inevitable outcome of past erroneous policies, that the disintegration of western civilization has come with the loss of unity within the Christian Church. What one would not guess is that this disunity is traced to a still more fundamental root, some kind of social conflict (171) using theological slogans (172). The solution offered for disunion is the restoration of religious unity in the Church (174). It would seem that a more plausible inference would be that the solution of the problem of political union would automatically take care of the religious question.

ALBERT E. AVEY

THE OHIO STATE UNIVERSITY

Personality. A Study According to the Philosophies of Value and Spirit of Max Scheler and Nicolai Hartmann. By ECKHARD J. KOEHLE. Newton, N.Y., 1941. Pp. xii, 232.

Whoever wishes to follow an industriously compiled list of quotations

from Scheler's and Hartmann's ethics has the opportunity to do so by reading Koehle's *Personality*. One will, however, not find there any satisfactory logical analysis and philosophical evaluation of phenomenological ethics. Koehle simply takes for granted a positive philosophical significance of phenomenology, and of phenomenological ethics in particular, in spite of existing proof to the contrary.

It should be mentioned especially that the emotionalism and the antinormativism of phenomenological ethics, both of which are incompatible with the very concept of scientific ethics, has not received any adequate criticism by Koehle.

JULIUS KRAFT

UNIVERSITY OF ROCHESTER, N.Y.

The following books have been received:

Formalization of Logic. By RUDOLF CARNAP. Studies in Semantics. Volume II. Cambridge, Massachusetts, Harvard University Press, 1943. Pp. xviii, 160.

A Philosophy of the Social Mode. By JOHN E. MACY. Boston, Massachusetts, Pemberton House, 1942. Pp. viii, 322.

Lewin's Topological and Vector Psychology. A Digest and a Critique. By ROBERT W. LEEPER. Eugene, Oregon, University of Oregon, 1943. Pp. x, 218.

Freedom Forgotten and Remembered. By HELMUTH KUHN. Chapel Hill, The University of North Carolina Press, 1943. Pp. viii, 268.

Science, Philosophy, and Religion. Third Symposium. New York, Conference on Science, Philosophy and Religion in their Relation to the Democratic Way of Life, Inc., 1943. Pp. xx, 438.

The Hero in History. A Study in Limitation and Possibility. By SIDNEY HOOK. New York, The John Day Company, 1943. Pp. xiv, 273.

Popular Freethought in America 1825-1850. By ALBERT POST. New York, Columbia University Press, 1943. Pp. 258. (London: P. S. King & Staples, Ltd.)

The Philosophy of Marsilio Ficino. By PAUL OSKAR KRISTELLER. Translated into English by VIRGINIA CONANT. New York, Columbia University Press, 1943. Pp. xiv, 441.

The Confessions of St. Augustine. Translated by F. J. SHEED. New York, Sheed and Ward, 1943. Pp. xxii, 354.

Roots of Bergson's Philosophy. By BEN-AMI SCHARFSTEIN. New York, Columbia University Press, 1943. Pp. x, 156.

Personalism in Theology. A Symposium in Honor of Albert Cornelius Knudson. By ASSOCIATES and FORMER STUDENTS. Edited by EDGAR SHEFFIELD BRIGHTMAN. Boston, Boston University Press, 1943. Pp. xii, 258.

The Christian Philosophy of History. By SHIRLEY JACKSON CASE. Chicago, Illinois, The University of Chicago Press, 1943. Pp. viii, 222.

Le problème du mal. Par PAUL SIWEK. Rio de Janeiro, Desclée, De Brouwer et Cie, 1942. Pp. vi, 162.

La réincarnation des esprits. Par PAUL SIWEK. Rio de Janeiro, Desclée, De Brouwer et Cie, 1942. Pp. 244.

NOTES

The forty-fifth regular meeting of the Creighton Club was held at Hobart College, May 1-2, 1943. Professors Boswell and Dimmick of Hobart College presented papers on "The Psychology of Knowledge", Professor Marvin Farber of the University of Buffalo presented a paper on "Phenomenology and Its Critics", and Professor Raymond Piper of Syracuse University a paper on "Aesthetics".

Frank C. Sharp, Professor Emeritus of Philosophy at the University of Wisconsin, died on May 4 at Madison at the age of 76. He had been a member of the university faculty for forty years and was chairman of the Department of Philosophy at the time of his retirement in 1936.

The following memorial resolution for Heinrich Gomperz was prepared by Professor R. T. Flewelling and H. Reichenbach in behalf of the Pacific Division of the American Philosophical Association:

The members of the Pacific Division of the American Philosophical Association note with extreme regret the passing of their esteemed colleague Professor Heinrich Gomperz on December 29, 1942 at Los Angeles.

Professor Gomperz was a man of sound learning and of great expository ability. He was a worthy successor of his father, the late Theodore Gomperz, and like him moved familiarly in the range of Greek philosophical scholarship. To this he added a meticulous knowledge of general philosophy both European and Oriental and a prodigious and exact memory. His own philosophical views represented an empiricism inclined to skepticism.

He surpassed in a capacity for clarifying ideas and in the ability to impart understanding to others.

He spent a long term of service as Professor at the University of Vienna. While he was spending a year (1937) as Visiting Professor in the School of Philosophy of the University of Southern California, his homeland Austria was annexed by Nazi Germany. He refused to conform with the Nazi regime and remained in his position at Southern California until his death, with the exception of a semester at the University of Illinois, and summer sessions at the University of Oregon.

We, the members of the Pacific Division, feel keenly the great loss that has befallen the University, the American Philosophical Association, and Philosophy in general. We extend to the bereaved wife and family our most heartfelt sympathy.

AMERICAN PHILOSOPHICAL ASSOCIATION
WESTERN DIVISION

Report on Committee on the Role of Philosophy in Higher Education, April 1943

The death, last summer, of its organizer and chairman, Charles Perry, has been a major loss to this committee. The war has also played havoc with its membership. The essential sub-committee on the teaching of

philosophy lost its chairman, D. S. Robinson, to the Navy, and of its regular members only Walker Hill, its secretary, continues. It has been reconstituted, however, and has not only carried on but has expanded its work. And there is reason to expect that in the coming year the work for which the Committee on the Role of Philosophy was established can be developed on a larger scale and under more favorable auspices than in the recent past.

The sub-committee continues its placement service, under war-time difficulties, and one more appointment has been made from the lists it supplies. Its study of the place of philosophy in the junior colleges, undertaken in collaboration with the American Association of Junior Colleges, is under way. It has also instituted an inquiry, among leaders in education, as to the way in which philosophy can most effectively serve in post-war education. It proposes to prepare a bibliography of literature on the teaching of philosophy, which should be of considerable use in the further study of this subject. It asks a continuance for another year of the appropriation by the Division of $125 to carry on its work. The committee has endorsed this program and request. It believes that the work of the sub-committee has been of notable value and that its continuance at this time is imperative.

It has become increasingly apparent that the whole problem of the function of philosophy in post-war education requires study and planning now, if we are to be at all prepared to meet the demands and difficulties with which we shall presently be confronted. The chairman of the committee instituted inquiries in January as to the manner in which such a study might best be undertaken and the possibility of securing a subsidy to support it. It was found that suggestions of a similar nature were being made in the Eastern Division and that a Commission was to be set up by the Association's National Board of Officers for just this purpose, with good prospects of substantial financial support. It has seemed best, therefore, to hold our own plans in abeyance until this Commission is constituted, and its relation to our Committee defined. As soon as these matters are settled, it will be the task of the committee to determine how best, in collaboration in the National Commission, it can contribute to this imperative work of post-war planning.

ARTHUR E. MURPHY, *Chairman*

The Committee:
A. E. Murphy, Chairman
A. C. Benjamin
C. J. Ducasse
W. S. Gamertsfelder
D. L. Evans
E. W. Hall, Chairman of the Subcommittee
Merritt H. Moore
H. D. Roelofs

The Subcommittee:
P. R. Anderson
G. R. Geiger
W. H. Hill, Secretary

The following is a list of articles in current philosophical periodicals:

PHILOSOPHY XVIII 69: *W. R. Inge*, The Philosophy of the Wolf State; *Alan Gewirth*, Gestalt Psychology; *E. S. Waterhouse*, Ethics and Christian Ethics; *Viscount Samuel*, The World After the War; *Clement C. J. Webb*, Apropos de Kierkegaard.

JOURNAL OF PHILOSOPHY XL 6: *Georges Gurvitch*, Is Moral Philosophy a Normative Theory?; *Max M. Laserson*, On the Sociology of Ethics; *C. J. Ducasse*, Esthetic Contemplation and Sense Pleasure—A Reply; *Robert F. Creegan*, Holism Must Be Historical. 7: *Arthur F. Bentley*, Truth, Reality, and Behavioral Fact; *John R. Reid*, Definitional Rules: Their Nature, Status, and Normative Function; *Carl Thurston*, Method in Esthetics. 8: *Roy Wood Sellars*, Verification of Categories: Existence and Substance; *Max Rieser*, On Will or the Levels of Action; *Walker H. Hill*, A Report to Teachers of Philosophy. 9: *Linclon Reis* and *Paul Oskar Kristeller*, Some Remarks on the Method of History; *Maurice Mandelbaum*, A Note on "Anthropomorphism" in Psychology.

PHILOSOPHY AND PHENOMENOLOGICAL RESEARCH III 3: *Moritz Geiger*, edited by *Herbert Spiegelberg*, An Introduction to Existential Philosophy; *Arthur Goodman*, Santayana's Ontology of Realms; *O. A. Kubitz*, Eduardo Nicol's Situational Psychology; *Sydney C. Rome*, The Scottish Refutation of Berkeley's Immaterialism; *Kurt Riezler*, Homer's Contribution to the Meaning of Truth; *Morris Weitz*, Does Art Tell the Truth?; *Charles Edward Gauss*, Epistemology, Referential or Representative?

THE JOURNAL OF SYMBOLIC LOGIC VIII 1: *R. M. Martin*, A homogeneous system for formal logic; *Ray H. Doterer*, A supplementary note on the rules of the antilogism; *M. J. Alban*, Independence of the primitive symbols of Lewis's calculi of propositions.

ETHICS LIII 3: *A Campbell Garnett*, Phenomenological Ethics and Self-Realization; *H. Gomperz*, When Does the End Sanctify the Means?; *M. C. Otto*, On a Certain Blindness in William James; *W. T. Jones*, On the Meaning of the Term "Influence" in Historical Studies; *Pitirim A. Sorokin*, The Study of War; *Hans Kelsen*, Quincy Wright's *A Study of War* and the *Bellum Justum*; *A. Cornelius Benjamin*, The Scientific Status of Value Judgments; *Charles Hartshorne*, Is Whitehead's God the God of Religion?

PHILOSOPHY OF SCIENCE X 2: *E. A. Burtt*, Method and Metaphysics in Sir Isaac Newton; *Harold N. Lee*, Scientific Method and Knowledge; *Cecil H. Miller*, Mind—A Study in Perspective; *George Gentry*, The Logic of the Sensum Theory; *Peter A. Carmichael*, Animadversion on the Null Class; *Charles E. Gauss*, The Interpretation of Implication; *Kurt H. Wolff*, The Sociology of Knowledge: Emphasis on an Empirical Attitude; *Ray Lepley*, The Identity of Fact and Value; *Henry Winthrop*, The Theoretical Basis of Biotypology; *Gregory Bateson*, The Science of Decency.

SCIENCE & SOCIETY VII 2: *Bernhard J. Stern*, Science and War Production; *Samuel Bernstein*, Jefferson and the French Revolution; *Paul Rosas*, Caste and Class in India; *A. D. Winspear* and *Edwin L. Miner, Jr.*, Athenian Democracy: Further Comments.

SOCIAL RESEARCH X 2: *Arnold Brecht*, Limited-Purpose Federations; *Richard Schüller*, Commercial Policy Between the Two Wars—Personal

Observations of a Participant; *Herbert Block,* Industrial Concentration versus Small Business—The Trend of Nazi Policy; *Hans Herma,* Goebbels' Conception of Propaganda; *Ernest Cassirer,* Hermann Cohen, 1842-1918; *Frieda Wunderlich,* The Beveridge Plan (Note).

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JEWISH SOCIAL STUDIES V 2: *Jacob Lestschinsky,* National Groups in Polish Emigration; *Salo W. Baron* and *Jeannette M. Baron,* Palestinian Messengers in America, 1849-79: A Record of Four Journeys; *Berthold Altmann,* Jews and the Rise of Capitalism: Economic Theory and Practice in a Westphalian Community.